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ABSTRACT

Technical notes are presented from a study that examined the degree to which cooperative education is a viable educational and/or financial aid mechanism for institutions of higher education to adopt. This volume gives graphs and tabular data on cohort selection, construction of net benefit streams (including graduate earnings and student experience), and rate of return methodologies. (LBH)

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COOPERATIVE EDUCATION - A NATIONAL ASSESSMENT

Technical Notes

Covers Period of Performance
During
July, 1975 - November, 1977

Contract No. OE-300-75-0343

Contractor

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Suite 701
962 Wayne Avenue
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Department of Health, Education, and Welfare
U.S. Office of Education
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400 Maryland Avenue, S.W.
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TECHNICAL NOTES

Discriminant Analysis

1. Overview of the Technique

Discriminant analysis is employed when one seeks to discriminate between two or more groups of individuals or objects on the basis of several properties of those individuals or objects. When the groups are fairly similar, it may be difficult to classify them into one group or another on the basis of an individual measurement. However, it may be possible to establish a linear combination of several measurements taken on the individuals involved whose distributions for the different groups would possess very little overlap. This linear combination is used to produce an index number which differentiates the individuals belonging to the different groups with a high percentage of success.

2. Application of the Technique

In this particular case there are two populations existing, and there are sample sets of observations from each: students participating in cooperative education and those not participating. To distinguish between the two groups, a set of discriminating variables that measure characteristics on which the two groups are expected to differ were selected.

A stepwise method of analysis was used.^{1/} In a stepwise analysis the "best" set of discriminating variables are selected

^{1/} The stepwise procedure utilized was Rao's V. It is a generalized distance measure. Variables are selected in the stepwise analysis which contribute to the largest increase in V when added to the variables which have been previously included in the analysis. Such a procedure results in an optimal set of variables being selected. These variables are selected according to various minimum criteria which are designated for the stepwise procedure. These criteria are set to define which variables will be included in the analysis and which will not. In this case the default values were utilized in order to assure that all variables which possess discriminatory power will be selected and retained for the analysis.

to enter the analysis based on their discriminating power. Variables are selected according to their ability to contribute to further discrimination, and the procedure stops when the remaining variables are no longer able to contribute to further separation. By utilizing stepwise discriminant analysis the less useful characteristics can be eliminated before the actual analysis is performed.

TECHNICAL NOTES TO THE RATE OF RETURN ANALYSIS

The rate of return analysis in the first part of Chapter 2 required the creation and analysis of cohort-specific net benefit streams. The task of these Technical Notes is to describe the selection of cohorts for analysis, the construction of net benefit streams for each of these cohorts, and the rate of return methodologies used to analyze each of these net benefit streams. These notes will be divided into three sections. Section A will describe the procedure by which cohorts were defined. Section B will detail the procedure by which data were adjusted and combined to create cohort-specific net benefit streams. Section C will describe the theory and practical application of each of the rate of return methodologies used in Chapter 2.

A. Cohort Selection

Section A is divided into three subsections. Subsection 1 discusses the selection of attributes used to define the student/graduate cohorts, and Subsection 2 describes the criteria for inclusion of observation in the cohorts so defined. Subsection 3 discusses the final set of cohorts for which observations were sufficient to be included in the rate of return analysis.

1. Cohort Characteristics Selection

The purpose of this section is to identify characteristics which may be used to define student/graduate cohorts. As a first

step, an examination identified ten candidate cohort characteristics, each of which will be discussed in turn.

a. Co-op versus Non-Co-op

Since the primary purpose of the study is to compare co-op and non-co-op curricula and graduate performance, the leading candidate characteristic is the participation or non-participation in the co-op program. It is only by including this characteristic that a major study objective of determining if graduates of co-op programs achieve higher economic returns from their college education than graduates of non-co-op programs can be accomplished.

b. Associate Degree versus Baccalaureate Degree

The Associate Degree (A.A.) - Baccalaureate Degree (B.A.) dichotomy is one of three institutional sampling stratifications in this study. The A.A. Degree is offered by 2-year junior colleges, while the B.A. is offered by colleges as 4-year and 5-year programs. One would expect earnings to differ because the level of investment differs significantly between them. At the same time, the skill level or the accumulation of human capital would be expected to be higher (and therefore graduate earnings) the longer the period of training, ceteris paribus.

c. IV-D Funding

The IV-D funded versus non-IV-D funded institution is another major sampling stratification. A IV-D funded school typically receives \$25,000 to \$35,000 annually for three fiscal years under Title IV-D of the Higher Education Act for support of its cooperative education program. While the major purpose of IV-D funding is to expand the scope of cooperative education programs, it may also be contended that the availability of this seed money increases the effectiveness of the cooperative education program and hence the skills acquired and future earnings received by the program participants.

d. State Unemployment Level

The unemployment level of the state in which the educational institution is located was also used in the institutional

sampling stratification process. The states were classified as high or low unemployment states according to their unemployment rate relative to the United States median. Since cooperative education involves employers, as well as schools, in the education process, it was expected that labor market conditions would have an impact on both the student and graduate experiences of participants in a co-op program.

e. Area of Training (Discipline Area)

Within sites, the samples of students (and program graduates also) were stratified according to five areas of training or discipline areas. These discipline areas are:

- Business and Management (B&M);
- Engineering/Architecture (E&A);
- Health Professions (HP);
- Liberal Arts (LA); and
- Trade and Industrial (T&I).

Care was taken within each site to obtain adequate representation for each of the five discipline areas. An important study objective was to determine if co-op is more successful in certain types of training areas than others. A co-op program's viability may vary by discipline area due to variations in labor market conditions among discipline areas. In addition, some discipline areas may produce graduates who are more career-oriented than others (e.g., Trade & Industrial vs. Liberal Arts).

f. Sex

Even a casual glance at Census data on earnings by sex is sufficient to determine that male and female earnings are different. Whether this is due to discrimination, skill level of occupational categories, or any combination of these factors, the fact remains that there are differences which should be taken into account when evaluating the returns to the investments in education.

g. Race

The discussion above regarding earning differences by sex often apply as well to earning differences by race. Differences exist, so that race should be considered as a candidate cohort characteristic for purposes of this study.

h. Region

While this factor is closely related to the unemployment level discussed above, it is possible that, in addition to regional variations in market conditions for program graduates, the technologies of the education process and the cost of education (tuition) may vary significantly by region. Thus, a regional breakdown was considered as a candidate characteristic.

i. Previous Work Experience

Another comparison criterion which may be related to graduate outcome is previous work experience. For example, one co-op student sampled in our survey was 38 years of age and earning an annual salary of well over \$20,000. The co-op program affords an opportunity for this individual to continue his education with an academic program that relates well to his present job, thereby facilitating his progression up the business career ladder. This situation can be further exemplified by considering that many co-op programs in 2-year colleges offer veterans; who already hold permanent full-time jobs, the opportunity to continue their education at night and receive academic credit for their work experience. Years of previous work experience was then considered as having an impact upon an individual's current earnings.

j. Postgraduate Education

To the extent that graduates of educational programs attend graduate schools rather than working in their chosen profession, their reported earnings will be lowered substantially. Thus, the decisions of graduates to further their education should be explicitly considered when conducting a cost-benefit analysis of the educational program.

While each of the characteristics listed above potentially affected the cost-benefit comparisons, it was not desirable to include them all in the rate or return analysis. The reasons were twofold: 1) the potential number of cohorts is very large, and 2) as a result, observations among the cohort cross-classification are likely to be extremely sparse. The next task, therefore, was to select those more important cohort characteristics which were to be included in the cost-benefit analysis. Since all of the characteristics could not be included in the rate of return analysis, a selection was made from among the candidates. In doing so, those few comparison groups were selected that would be most meaningful for an analysis of economic returns to graduates.

As indicated previously, for the purpose of fulfilling our study objectives the most important comparison is of co-op participants against non-co-op participants. This comparison is necessary to determine if cooperative education offers any unique or additional economic advantage compared to other forms of undergraduate education.

The second comparison criterion selected was the Associate versus Baccalaureate Degree program. This criterion was selected because student costs vary significantly depending on whether the program is two, four, or five years in length, because during this period the student delays the arrival of graduate earnings, foregoes earnings resulting from high school education, and continues to incur direct costs of education (e.g., tuition, books). Using this variable to define the cohorts for analysis also allows the examination of the extent to which increased years of schooling lead to increased earning capacity to compensate for the higher costs.

A third comparison characteristics used for cohort selection was to disaggregate observations of students/graduates in the sample according to the five discipline areas. The rationale for this selection was that an important component of the study objectives was to investigate outcomes for different curricula. In addition to the possibility that student costs and economic returns may differ by discipline area, co-op program characteristics are likely to differ according to discipline area as well.

The final cohort characteristic selected was sex, since labor force participation rates and earnings have traditionally varied by sex, significant variations in male/female proportions across cohorts not defined according to this characteristic would seriously bias measures of the economic return differences across cohorts.

Thus, a total of four characteristics were chosen by which 60 cohorts were defined. This does not mean to say that the other characteristics were ignored. Some of the other characteristics which clearly impact on the student/graduate experience were used to screen observations from inclusion in the cohorts rather than define the cohorts themselves. Thus, observations on those with previous experience and those attending graduates school were excluded from the rate of return analysis. These observations were included, however, when examining the graduates and student experiences separately. At the same time, these later analyses included consideration of characteristics such as the unemployment level, race, region, IV-D funding, etc. The process of selecting observations for inclusion in the 60 cohorts of the rate of return analysis is explained in the next subsection.

2. Cohort Sample Selection

Having defined the 60 potential cohorts, the next step was to identify those observations which were to be included in each cohort. Three criteria were used to select student and graduate observations for the cohorts of the rate of return analysis:

- Each observation must conform with the cohort definition.
- Observations associated with previous experience, or post-graduate study, and those from institution without both student and graduate observations were eliminated.
- Each observation had to represent "good" data.

a. Cohort Definition Variables

The sex and co-op status of each student/graduate respondent were taken directly from the respective questionnaires without any need for data editing or recoding. The variables for discipline area and program length, however, required some additional coding. Students and graduates had to be grouped into the five discipline areas of Business & Management, Engineering & Architecture, Health Professions, Liberal Arts, and Trade & Industrial. The relevant questionnaire responses, however, reported only the student's/graduate's college major. These majors were coded on the questionnaires according to the Higher Education General Information Survey (HEGIS) subdivisions which had to be recoded into the five discipline areas used in cohort definition. This placement of HEGIS codes within one of the five discipline areas is illustrated in Table T.1. It will be noted that several possible academic majors could not be recoded into any of the five discipline areas, so that students or graduates who participated in these areas of study were not included in the rate of return analysis.

Program length is normally either two or four years as determined from precoded information based on the type of institution being examined. Some of the programs in the four year or Baccalaureate schools were actually five years in length as determined from the cooperative education director questionnaire. Accordingly, the correct program length (specific by school and discipline area) was appended directly to each student/graduate record and used for cohort placement.

b. Previous Experience and Post-Graduate Study

In order to eliminate those students and graduates whose ages are outliers for their particular year in school or year since graduation, and, therefore, are presumed to have some level of previous experience, distributions of ages for each year

TABLE T.1: DISCIPLINE AREAS AS DEFINED BY THE HIGHER EDUCATION GENERAL INFORMATION SURVEY (HEGIS) SUBDIVISIONS

Business & Management

- Business & Management (HEGIS 0500)
- Computer and Information Sciences (HEGIS 0700)
- Business and Commerce Technologies (HEGIS 5000)
- Data Processing Technologies (HEGIS 5100)

Engineering & Architecture

- Architecture and Environmental Design (HEGIS 0200)
- Engineering (HEGIS 0900)

Health Professions

- Health Professions (HEGIS 1200)
- Health Services and Paramedical Technologies (HEGIS 5200)

Omitted

- Agriculture and Natural Resources (HEGIS 0100)
- Education (HEGIS 0800)
- Home Economics (HEGIS 1300)
- Law (HEGIS 1400)
- Military Sciences (HEGIS 1800)
- Theology (HEGIS 2300)

Liberal Arts

- Area Studies (HEGIS 0300)
- Biological Sciences (HEGIS 0400)
- Communications (HEGIS 0600)
- Fine and Applied Arts (HEGIS 1000)
- Foreign Languages (HEGIS 1100)
- Letters (HEGIS 1500)
- Library Science (HEGIS 1600)
- Mathematics (HEGIS 1700)
- Physical Sciences (HEGIS 1900)
- Psychology (HEGIS 2000)
- Public Affairs and Services (HEGIS 2100)
- Social Sciences (HEGIS 2200)
- Interdisciplinary Studies (HEGIS 4900)
- Public Service Related Technologies (HEGIS 5500)

Trade & Industrial

- Mechanical and Engineering Technologies (HEGIS 5300)
- Natural Sciences Technologies (HEGIS 5400)

in school and years since graduation had to be generated and cutoff ages selected. Unfortunately, neither students nor graduates were asked their year in school or age at graduation, so that both had to be calculated based upon available questionnaire data. For students, the year in school was calculated based upon the known length of program and the percentage of graduation credits taken or in the process of being completed. The year in school, Y, was calculated according to:

$$Y = \frac{P(T+C)}{N}$$

where T is the total credits being taken at the time of the interview, C is the total credits already completed, N is the credits needed for graduation, and P is the length of the program in years. As $(T + C)/N$ may vary from zero to one, this formula may produce a number which varies from zero to P. By recording the number so obtained up to the nearest integer, the year in school for the student was determined and so appended to the student record.

The calculation was somewhat similar for program graduates. The number of months from the date of graduation to the date of questionnaire completion was calculated, divided by 12, and rounded up to the nearest integer to determine the year since graduation at the time the questionnaire was administered. Ages of the graduates for all other years since graduation were then calculated by successively subtracting one year from the age at questionnaire completion.

Distributions of ages across the entire set of observations for each program length were calculated for each year in school and year since graduation and cutoff ages selected. These cutoffs represent those age ranges within which it could be accepted that the student/graduates had not had previous experience prior to school entry. The resulting age ranges for students and graduates by program length and year in school or years since graduation are presented in Table T.2.

TABLE T.2: ACCEPTABLE STUDENT/GRADUATE AGE RANGES FOR YEAR IN SCHOOL AND YEARS AFTER GRADUATION BY PROGRAM LENGTH

		PROGRAM LENGTH		
		2-YEAR	4-YEAR	5-YEAR
Y E A R I N S C H O O L	1	17-20	17-20	17-20
	2	18-21	18-21	18-21
	3		19-22	19-22
	4		20-23	20-23
	5			21-24
ASSUMED AGE AT COLLEGE GRADUATION ^{1/}		21	23	24
Y E A R A F T E R G R A D U A T I O N	1	19-22	21-24	22-25
	2	20-23	22-25	23-26
	3	21-24	23-26	24-27
	4	22-25	24-27	25-28
	5	23-26	25-28	26-29
	6	24-27	26-29	27-30

^{1/} Derivation will be explained below in text, but assumes the high school graduate turns 19 on the day of graduation.

Finally, it was necessary that student and graduate data represent the same distribution of schools, since student earnings and expenditures and subsequent graduate earnings were both theorized to be partially dependent upon the particular school attended. Several schools for which student data was available did not provide corresponding graduate data; primarily because these were new programs without graduates. Similarly, several schools provided graduate lists for mailout surveys, but no on-site visits were made to accumulate student data. Therefore, of the schools providing student data and the schools providing graduate data, only the intersection of these two sets was used for the rate of return analysis as shown in Figure T.1.

c. Data Cleanliness

Several additional criteria other than those listed above were used to select the student and graduate data records which would be used to construct the cohort-specific net benefit streams. An additional criterion which students/graduates had to meet for inclusion in the rate of return analysis was consistent and "clean" earnings and expenditure data. For the graduates, earnings and employment histories for each individual were constructed from their responses to questions related to jobs and unemployment experience.

- Starting and ending dates had to be reported for each job. Starting dates had to be between September, 1966 and December, 1976. Job ending dates had to be later than starting dates in each case.
- Salaries had to be reported for each starting and ending date.
- Jobs had to be reported in the following order:
 - .. first job,
 - .. second job, and
 - .. most recent job.
- For non-work periods, a report of a "next-most recent" non-work period was only acceptable if a "most recent" non-work period was reported.

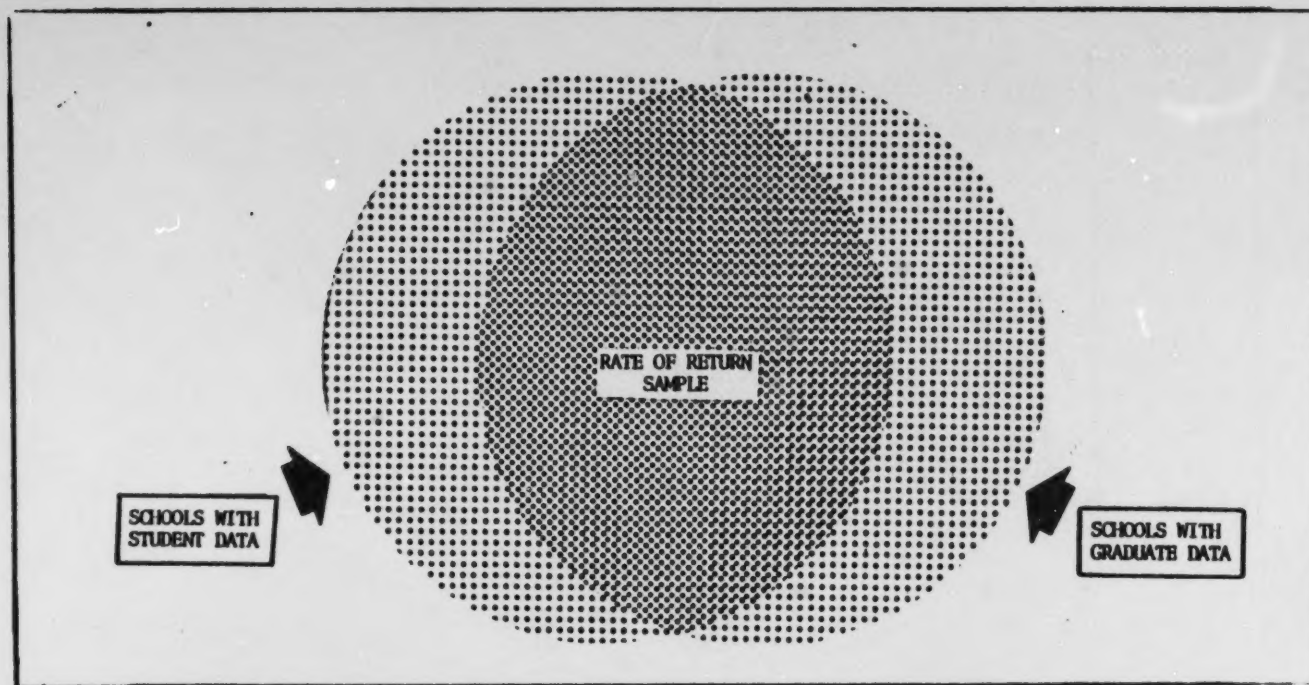


FIGURE T.1: RATE OF RETURN SAMPLE AS THE INTERSECTION OF SCHOOLS WITH BOTH STUDENT AND GRADUATE DATA

- Dates reported for non-work periods had to be consistent and could not conflict with dates reported for any job.

For student data records, similar criteria had to be met, related to expenditure and income, for inclusion in the rate of return analysis.

- Total yearly expenditures had to be positive and individual expenditure items had to sum to this amount.
- Income and transfer payment items were permitted to be zero.

Each student/graduate data record which conformed to the cohort definition variables; which was consistent with the requirements of age, school, lack of previous experience, and no post-graduate experience; and exhibited "clean" and consistent earnings and employment data was acceptable for the rate of return analysis.

3. Final Cohort Selection

Having identified a series of 60 potential cohorts for the rate of return analysis, and having made selections of observations for each of these cohorts, the decision had to be made regarding the sufficiency of observation so that the final analytical set of cohorts could be identified. Two criteria were used to identify the final cohort set, both dealing with the number of graduate observations, and aimed at ensuring sufficient observations to generate full lifetime graduate earnings profiles. The first of these was to require that at least three years of graduate data were available for the cohort, and the second was that at least four observations be present in the cohort for the third year since graduation.

Table T.3 presents the resulting number of observations on third-year graduate earnings for each cohort. The non-integer

TABLE T.3: THIRD YEAR EARNINGS SAMPLE SIZES BY COHORT^{1/}

Program Length	2 Year				4 Year				5 Year ^{2/}
Discipline	Co-op		Non-co-op		Co-op		Non-co-op		Co-op
	Male	Female	Male	Female	Male	Female	Male	Female	Male
Engineering & Architecture	5.9	X	9.2	X	75.5	X	117.1	X	143.8
Business & Management	16.1	30.6	64.8	102.4	45.7	5.8	111.4	24.3	27.8
Health Professions	X	6.4	X	36.0	X	X	11.0	33.8	X
Liberal Arts	4.0	10.9	44.0	43.6	13.9	10.7	143.8	111.7	X
Trade & Industrial	X	X	25.2	X	X	X	8.0	X	X

^{1/} Cohorts with samples less than 4 are indicated with an "X."

^{2/} No observations were made on females or non-co-op males with 5 year program lengths.

values observed are due to their being means of the observations for each month during the third year since graduation.^{1/} Note that out of the 60 potential cohorts only 28 cohorts had four or more observations of third year earnings and could be used in the rate of return analysis. This number is almost double the number originally expected, however.

B. Construction of Net Benefit Streams

For each of the 28 available cohorts, net benefit streams were constructed using data elements which may be divided into four main groups:

^{1/} A full description of the procedure used to construct and calculate the graduate earnings stream by month from the reported graduate data is presented in Section B, below.

- graduate earnings from the graduate sample adjusted for inflation and by comparison with appropriate Census earnings figures;
- elements of the student experience: books, tuition, taxable and non-taxable student earnings, etc.;
- foregone earnings for both students and graduates using the expected earnings represented by the income endowment of a high school graduate of the same age and sex; and
- adjustments for cross-section data bias, taxes, and probability of survival.

Section B. will be divided into four subsections. Subsection 1 will discuss the measurement of cohort-specific graduate earnings from the questionnaire, its adjustment for inflation, and the creation of lifetime income streams by comparison with appropriate Census data. Subsection 2 will discuss the elements of the student experience and how they are created from student data records. Subsection 3 will comment on the foregone earnings of students and graduates and how these are created from Census data. Subsection 4 will discuss the various adjustments of cross-section data bias, taxes, and survivorship and how these are used in conjunction with the other data elements and will conclude with a discussion of the procedure by which these varied data elements are merged to create cohort-specific net benefit streams. This is in preparation for Section C which will describe the use of these streams in the rate of return analysis.

1. Graduate Earnings

The creation of lifetime yearly earnings figures for each cohort was accomplished in three main stages. First, annual earnings figures were created for each cohort from the salary and employment history in the questionnaire data. Second, Census earnings data were used to create standard lifetime profiles for each cohort. Finally, the annual graduate earnings figures generated during the first stage were used to adjust the standard lifetime income profile from the Census to arrive at lifetime graduate earning streams for the rate of return analysis.

a. Creation of Cohort-Specific Annual Graduate Earnings

After the graduate questionnaire records passed the editing and sample requirements as described in Section A.2, the earnings and employment data were used to construct monthly (and yearly) earnings figures for each cohort for up to six years past graduation. This procedure was in several steps:

(1) The date at graduation is the beginning of the graduate period of interest, whether or not the initial employment began before or after this date. If the first employment period began before graduation, the reported initial salary was adjusted linearly to correspond to the date at graduation as shown in Figure T.2. On the other hand, if the first job started after graduation, the period of unemployment was calculated in months by assuming that graduation took place at the end of the month indicated, while a new job is assumed to start at the beginning of the month indicated. Thus, a graduation date of June 1975 and a job start date of July 1975 imply no period of unemployment. By assuming that job terminations are at the end of the month indicated, the calculations of Figure T.2 should become clear.

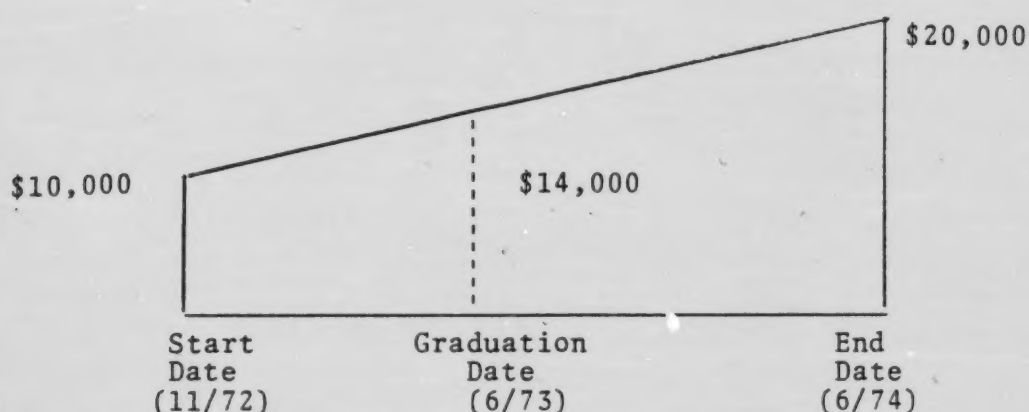


FIGURE T.2: CALCULATION OF GRADUATE EARNINGS AT DATE OF GRADUATION WHEN JOB STARTED PRIOR TO GRADUATION

(2) A time frame was constructed consisting of the starting and ending dates (months) of all reported jobs and periods of non-work. Associated with each of these months was a salary figure (\$0 for non-work months). In addition, some months were outside of the observed reporting period (e.g., month 25, 26, etc. when graduation was 24 months ago). As a result, no observations could be recorded for the individual. Therefore, care was taken to differentiate between "non-observed" earnings and zero earnings observed during a non-work period.

(3) Each individual within a specific cohort was counted as an observation for each month after graduation during which earnings data was observed or could be interpolated. All interpolated monthly earnings were then calculated for an individual by assuming a linear change between the reported starting and ending salaries.

(4) Individual monthly earnings were converted to June, 1969 dollars in order to approximate Census dollars. The deflation index used for each month was the Consumer Price Index as reported by the Bureau of Labor Statistics, Monthly Labor Review. These monthly deflators are exhibited in Table T.4.

(5) Within each cohort, mean monthly graduate earnings were calculated by the following formula:

$$(1) \quad E_j = \frac{1}{n_j} \sum_{i=1}^{n_j} E_{ij},$$

where E_j is the mean cohort-specific graduate earnings for month j , n_j is the number of observations in month j , and E_{ij} is the graduate earnings for individual i in month j .

(6) The mean annual earnings for each cohort were then calculated by summing the product of the mean monthly graduate earnings and the number of observations for each month over the entire year, and then dividing by the total monthly cohort

TABLE T.4: CONSUMER PRICE INDEX (JUNE 1969 = 100.0)

DATE	C.P.I.	DATE	C.P.I.	DATE	C.P.I.
June, 1969	100.0	November, 1971	111.8	April, 1974	131.2
July, 1969	100.5	December, 1971	112.2	May, 1974	132.6
August, 1969	100.9	January, 1972	112.3	June, 1974	133.9
September, 1969	101.4	February, 1972	112.9	July, 1974	134.9
October, 1969	101.7	March, 1972	113.0	August, 1974	136.6
November, 1969	102.3	April, 1972	113.3	September, 1974	138.3
December, 1969	102.9	May, 1972	113.7	October, 1974	139.5
January, 1970	103.3	June, 1972	113.9	November, 1974	140.7
February, 1970	103.8	July, 1972	114.4	December, 1974	141.7
March, 1970	104.4	August, 1972	114.6	January, 1975	142.3
April, 1970	105.0	September, 1972	115.0	February, 1975	143.3
May, 1970	105.5	October, 1972	115.4	March, 1975	143.8
June, 1970	106.0	November, 1972	115.7	April, 1975	144.6
July, 1970	106.4	December, 1972	116.0	May, 1975	145.2
August, 1970	106.6	January, 1973	116.4	June, 1975	146.4
September, 1970	107.1	February, 1973	117.2	July, 1975	147.9
October, 1970	107.7	March, 1973	118.3	August, 1975	148.4
November, 1970	108.0	April, 1973	119.1	September, 1975	149.1
December, 1970	108.6	May, 1973	119.9	October, 1975	150.0
January, 1971	108.7	June, 1973	120.7	November, 1975	150.9
February, 1971	108.8	July, 1973	121.0	December, 1975	181.6
March, 1971	109.2	August, 1973	123.2	January, 1976	152.0
April, 1971	109.6	September, 1973	123.5	February, 1976	152.3
May, 1971	110.1	October, 1973	124.5	March, 1976	152.7
June, 1971	110.8	November, 1973	125.4	April, 1976	153.3
July, 1971	111.0	December, 1973	126.3	May, 1976	154.2
August, 1971	111.3	January, 1974	127.3	June, 1976	155.1
September, 1971	111.4	February, 1974	129.0	July, 1976	156.0
October, 1971	111.6	March, 1974	130.4	August, 1976	156.7

observations during the year divided by 12. The following formula demonstrates the calculations to be undertaken to determine the annual cohort earnings for the first year following graduation $\bar{E}_1$:

$$(2) \quad \bar{E}_1 = \left(\sum_{j=1}^{12} n_j E_j \right) / \left(\sum_{j=1}^{12} n_j / 12 \right).$$

For years other than the first year, the months of the summation over j change from 1-12 (for $\bar{E}_1$) to 12-24 (for $\bar{E}_2$) to 24-36 (for $\bar{E}_3$), etc. Obviously, the sample sizes as reported earlier in Table T.3 refer to the denominator of equation (2) with the summation going from 24 to 36.

(7) The output of this procedure to this point represents cohort-specific annual earnings figures for each year after graduation. If these earnings are to be compared to age-specific Census earnings figures, a precise interface must be provided between the graduate's age and year since graduation. Thus, in accordance with the distributions shown in Table T.2, ages were assigned to the cohort-specific earnings figures which were derived according to equation (3):

$$(3) \quad \text{AGE} = 18 + Y + P$$

where Y equals the year since graduation and P equals the program length appropriate to that particular cohort. Note that the age at graduation for each program length can be ascertained by setting Y equal to one and solving for alternative values of P . This means that the ages at graduation shown on Table T.2 assume that each graduate has a birthday on the day of graduation. By setting both Y and P equal to zero the age during the final year of high school is 18.

b. Creation of Standard Lifetime Cohort-Specific Earnings Streams from Census Data

To this point only up to six years of graduate earnings have been generated for each cohort. This step is to use

Census data to construct a standard lifetime income profile which is in turn to be used in combination with the graduate earnings to construct graduate lifetime earnings. It is primarily the shape of the standard curve over a cohort lifetime which is most important at this stage, and not the level of the earnings. These standard curves will act as a template on which the earnings experience of the sample data may be shaped. This creation of earnings streams from the Census was accomplished in essentially three steps.

(1) The first step was to develop a cross-reference between the five discipline areas and the Census-defined occupational categories. This was accomplished in a manner similar to that used to define college majors in terms of these same five discipline areas. Table T.5 shows the occupational categories as defined by the Census which were incorporated into each of the five discipline areas.

The data source used for Census earnings data was Earnings by Education and Occupation, PC(2)-8B. This source contains occupational-specific earnings figures tabulated by age, sex, and years of school. Within each age, sex, and education category, earnings were calculated by the following formula for each cohort:

$$(4) \quad I_a = \sum_{\ell=1}^L (P_{a\ell} \cdot I_{a\ell}) / \sum_{\ell=1}^L P_{a\ell},$$

where I_a is the Census earnings in age group a for a cohort, $P_{a\ell}$ is the number in age group a in the occupation ℓ in the cohort, $I_{a\ell}$ is the earnings of those in age group a in occupation ℓ in the cohort, and L is the number of occupational categories in the discipline area of the cohort. In other words, cohort earnings were calculated from the Census occupational figures using the Census population distribution as weights.

TABLE T.5: DISCIPLINE AREAS AS COMPOSED OF CENSUS OCCUPATION CATEGORIES

Business & Management

- Accountants
- Computer Specialists
- Operation and System Researchers and Analysts
- Personnel and Labor Relations Workers
- Managers and Administrators, Except Farm
- Sales Workers
- Clerical and Kindred Workers

Engineering & Architecture

- Architects
- Engineers

Health Professions

- Nurses, Dietitians, and Therapists
- Health Technologists and Technicians
- Health Service Workers

Liberal Arts

- Librarians, Archivists, and Curators
- Mathematical Specialists
- Life and Physical Scientists
- Social Scientists
- Social and Recreation Workers
- Writers, Artists, and Entertainers
- Protective Service Workers

Trade & Industrial

- Engineering and Science Technicians
- Technicians, Except Health, and Engineering and Science
- Craftsmen and Kindred Workers
- Operatives, Except Transport
- Transport Equipment Operatives
- Laborers, Except Farm
- Cleaning Service Workers
- Food Service Workers

(2) The earnings figures derived from the Census data contain those individuals who reported that they had worked sometime during the reporting year and, thus, have positive earnings. These figures are, therefore, only partially adjusted for labor force participation rates. The age and cohort-specific earnings figures derived from the Census had to be further adjusted downward to account for that portion of the population which did not work at all during the year, i.e., those with zero earning. Another 1970 Census publication, Employment Status and Work Experience, PC(2)-6A contains data from which these labor force participation rates based upon age, sex, and years of schooling may be calculated. These participation rates were calculated by dividing the total number of civilians in the cohort who were employed sometime during the year by the totally experienced civilian labor force in the cohort. The resultant participation rates are reported in Table T.6 for each age, sex, and education cohort.

It will be noted that two assumptions are required in the use of these participation rates. First, since these participation rates are specific only by age, sex, and education, it must be assumed that these labor force participation rates remain constant across occupations and, therefore, discipline areas. Second, separate employment figures were not reported for five years of schooling as opposed to four years. It is assumed, therefore, that participation rates are constant across these two categories. The participation rates reported in Table T.6 were applied to the appropriate age-specific cohort Census earnings figures with equivalent sex and years of school parameters.

(3) To this point, therefore, adjusted Census earnings figures are available for cohorts of the four age categories of 18-24, 25-34, 35-54, and 55-64. It is evident that the cohort-specific adjusted earnings figures, with only these four age groupings, are not yet sufficient for the purposes of this study. As shown in Figure T.3, these four age categories form a step function earnings profile. This step will outline the approach used to smooth or otherwise convert this step function of Census earnings into a continuous curve as also shown on Figure T.3.

TABLE T.6: LABOR FORCE PARTICIPATION RATES BY AGE, SEX, AND YEARS OF SCHOOL^{1/}

CRITERIA		AGE			
		18-24	25-34	35-54	55-64
M A L E	Education: High School	.732	.938	.940	.840
	2 Years	.580	.914	.942	.844
	4,5 Years	.760	.932	.970	.882
F E M A L E	Education: High School	.540	.425	.518	.458
	2 Years	.515	.450	.519	.468
	4,5 Years	.769	.574	.618	.610

^{1/} Labor force participation rates defined as those civilian employed at one time during the year as a proportion of the experienced civilian labor force in each cohort.

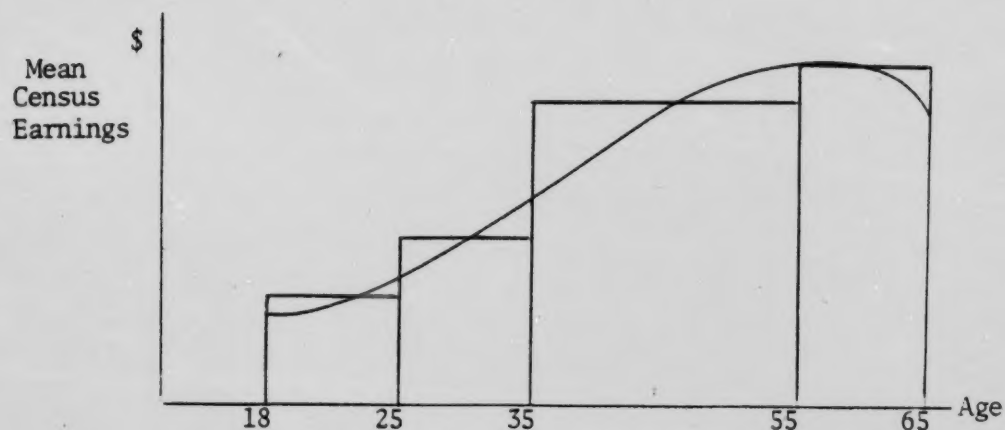


FIGURE T.3: TYPICAL MEAN CENSUS EARNINGS BY AGE

The integral of a continuous curve over each range of ages must equal the mean earnings over that age range multiplied by the number of years in that range. In other words, the area under the curve within the age range must equal the area of the block associated with each age range as depicted in Figure T.3. These conditions may be translated into more formal mathematical terms by the following four equations:

$$(5a) \quad \int_{55}^{65} F(a) = (65-55)(M_{55-65}),$$

$$(5b) \quad \int_{35}^{55} F(a) = (55-35)(M_{35-55}),$$

$$(5c) \quad \int_{25}^{35} F(a) = (35-25)(M_{25-35}), \text{ and}$$

$$(5d) \quad \int_{18}^{25} F(a) = (25-18)(M_{18-25}),$$

where $F(a)$ represents an earnings curve as a function of age and where M_{18-25} is, for instance, the mean earnings for a cohort between the ages of 18 and 25 as developed from the Census data. To specify a functional form for $F(a)$, it has been assumed that earnings for a given cohort are a function of age in the form:

$$(6) \quad I_a = \beta_1 + \beta_2(a) + \beta_3(a^2) + \beta_4(a^3)$$

where I_a is age-specific earnings for the cohort and β_1 through β_4 are coefficients representing the influence of age (a) on cohort earnings. The area under the curve described by this function may be found by integration:

$$(7) \quad \int I_a(\partial a) = \beta_0 + \beta_1(a) + \frac{1}{2} \beta_2(a^2) + \frac{1}{3} \beta_3(a^3) + \frac{1}{4} \beta_4(a^4)$$

The curve fitting-conditions in equations (5a)-(5d) may now be restated by evaluating equation (7) through each age range:

$$\begin{aligned}
(8) \quad & (25-18)(\beta_1) + \frac{1}{2}(25^2-18^2)(\beta_2) + \frac{1}{3}(25^3-18^3)(\beta_3) + \frac{1}{4}(25^4-18^4)(\beta_4) = (25-18)(M_{18-25}) \\
(9) \quad & (35-25)(\beta_1) + \frac{1}{2}(35^2-25^2)(\beta_2) + \frac{1}{3}(35^3-25^3)(\beta_3) + \frac{1}{4}(35^4-25^4)(\beta_4) = (35-25)(M_{25-35}) \\
(10) \quad & (55-35)(\beta_1) + \frac{1}{2}(55^2-35^2)(\beta_2) + \frac{1}{3}(55^3-35^3)(\beta_3) + \frac{1}{4}(55^4-35^4)(\beta_4) = (55-35)(M_{35-55}) \\
(11) \quad & (65-55)(\beta_1) + \frac{1}{2}(65^2-55^2)(\beta_2) + \frac{1}{3}(65^3-55^3)(\beta_3) + \frac{1}{4}(65^4-55^4)(\beta_4) = (65-55)(M_{55-65})
\end{aligned}$$

These four equations may then be used to solve for β_1 through β_4 . The conditions expressed here may be solved and put into matrix form:

$$\begin{bmatrix} 1 & 21.5 & 466.3 & 10201.75 \\ 1 & 30 & 908.3 & 27750 \\ 1 & 45 & 2058.3 & 95625 \\ 1 & 60 & 3608.3 & 217500 \end{bmatrix} \begin{bmatrix} \beta_1 \\ \beta_2 \\ \beta_3 \\ \beta_4 \end{bmatrix} = \begin{bmatrix} M_{18-25} \\ M_{25-35} \\ M_{35-55} \\ M_{55-65} \end{bmatrix}$$

By inverting the above lefthand matrix, the coefficients β_1 through β_4 may be found:

$$\begin{bmatrix} \beta_1 \\ \beta_2 \\ \beta_3 \\ \beta_4 \end{bmatrix} = \begin{bmatrix} 10.807428 & -16.117364 & 8.4956631 & -2.1857269 \\ -.7881473 & 1.3895514 & -.8228579 & .2214539 \\ .0182661 & -.0356913 & .024499 & -.0070745 \\ -.0001353 & .0002829 & -.0002185 & .0000709 \end{bmatrix} \begin{bmatrix} M_{18-25} \\ M_{25-35} \\ M_{35-55} \\ M_{55-65} \end{bmatrix}$$

Given an adjusted mean earnings figure for each of four ages ranges from the Census data for each cohort, this matrix equation system solves for the coefficients which, when entered in equation (6), produce a function which provides a continuous stream of earnings over each age range equal to the earnings reported in the Census data. Such a function is shown as the continuous curve in Figure T.3.

c. Adjustment of Standard Census Earnings Lifetime Profiles to Graduate Sample Data

Even though the sample graduate data and the Census earnings streams are intended to measure the earnings of approximately the same cohorts, the resultant Census earnings streams and graduate data observations seldom matched. That is, the first three to six years of the Census earnings stream seldom coincided with the first

three to six observations on the earnings of graduates sampled.^{1/} Certain alternative relationships were often observed between them, however, Sometimes the two series were parallel so that a constant absolute differential was implied, other times a constant proportional difference was implied, often a declining proportional relationship was implied with the limit being one or some other proportion, and many times more than one adjustment appeared as plausible as another.

The entire Census curve was adjusted by the implied differential or proportion. When more than one adjustment was implied, all adjustments were made (separately, of course) and the selection finally made on the basis of rate of return sensitivity tests. That is, internal rates of return were generated for each implied adjusted lifetime income stream. If the spread of internal rates for a given cohort was greater than 1.5 percentage points, then the "high" and the "low" were both retained and the full rate of return analysis was run for both and reported as such. On the other hand, if the spread of internal rates of return were 1.5 percentage points or less, only the "best" adjusted stream was retained for the full rates of return analysis. The "best" stream was chosen for each cohort prior to the sensitivity tests on the basis of the simplicity of the adjustment and other subjective considerations.

Full documentation of the construction of the alternatives and the final choices made among the alternatives is presented for each of the 28 cohorts in Exhibits T.1 through T.28. The first several years of the Census earnings stream are compared with the first three to six years of graduate earnings in the lower left quadrant of each exhibit. Based on these comparisons, alternative

^{1/} Only those graduate earnings years were used that were based on 4 or more observations. Since this was the criterion for inclusion of the cohort, at least 3 years of graduate earnings were available for all cohorts.

EXHIBIT T.1: GRADUATE EARNINGS OF THE BUSINESS FEMALE CO-OP 2-YEAR COHORT

BUSINESS FEMALE COOP 2-YEAR

AGE	ERN	GRAD	BMFC2A	BMFC2B	BMFC2C
20.	1314.	0.	0.	0.	0.
21.	1404.	3270.	3904.	3731.	3808.
22.	1494.	3969.	3998.	3969.	3958.
23.	1584.	4195.	4084.	4197.	4044.
24.	1665.	2009.	4166.	4415.	4126.
25.	1745.	0.	4245.	4624.	4205.
26.	1820.	0.	4320.	4874.	4280.
27.	1892.	0.	4392.	5014.	4352.
28.	1960.	0.	4460.	5194.	4420.
29.	2025.	0.	4525.	5366.	4485.
30.	2086.	0.	4586.	5529.	4546.

ALTERNATIVE ADJUSTMENTS TO CENSUS EARNINGS FOR THE COHORT - BUSINESS FEMALE CO-OP 2-YEAR

Age	Constant Difference (BMFC2A)	Constant Proportion (BMFC2B)	Constant Difference (BMFC2C)
20	0	0	0
21	+ \$2500	x 2.65	+ \$2460
22	+ \$2500	x 2.65	+ \$2460
23	+ \$2500	x 2.65	+ \$2460
24	+ \$2500	x 2.65	+ \$2460
25	+ \$2500	x 2.65	+ \$2460
26	+ \$2500	x 2.65	+ \$2460
27	+ \$2500	x 2.65	+ \$2460
28	+ \$2500	x 2.65	+ \$2460
29	+ \$2500	x 2.65	+ \$2460
30	+ \$2500	x 2.65	+ \$2460
...	...	...	...
65	+ \$2500	x 2.65	+ \$2460

Estimated Census earnings data (ERN), graduate sample data (GRAD), and all adjusted streams for ages 20-30.

Streams created by additive or multiplicative adjustment of the Census for the ages 20-65. "+" indicates a constant or varying amount added to the Census earnings data each year. "x" indicates a constant or varying factor multiplied times Census earnings. Zero earnings are specified for all years before graduation.

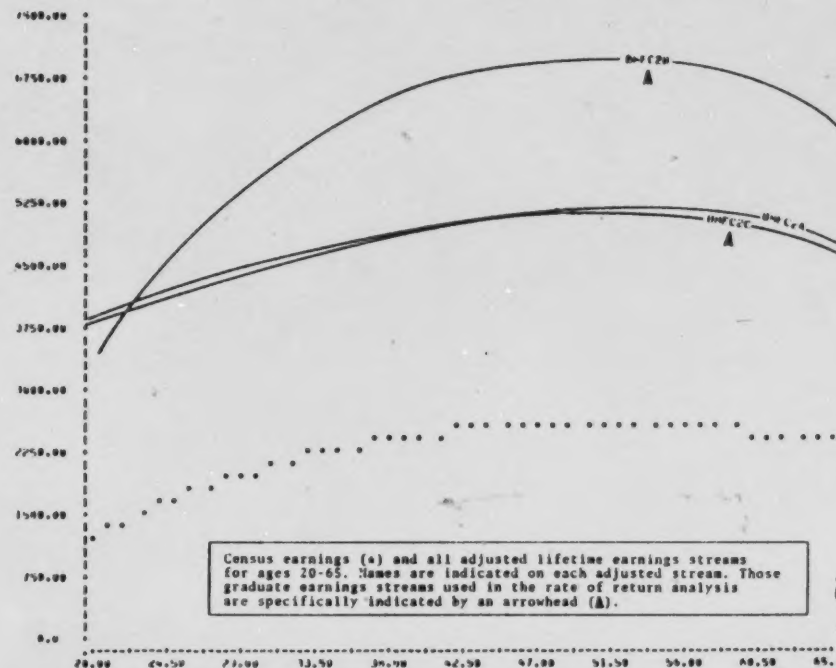
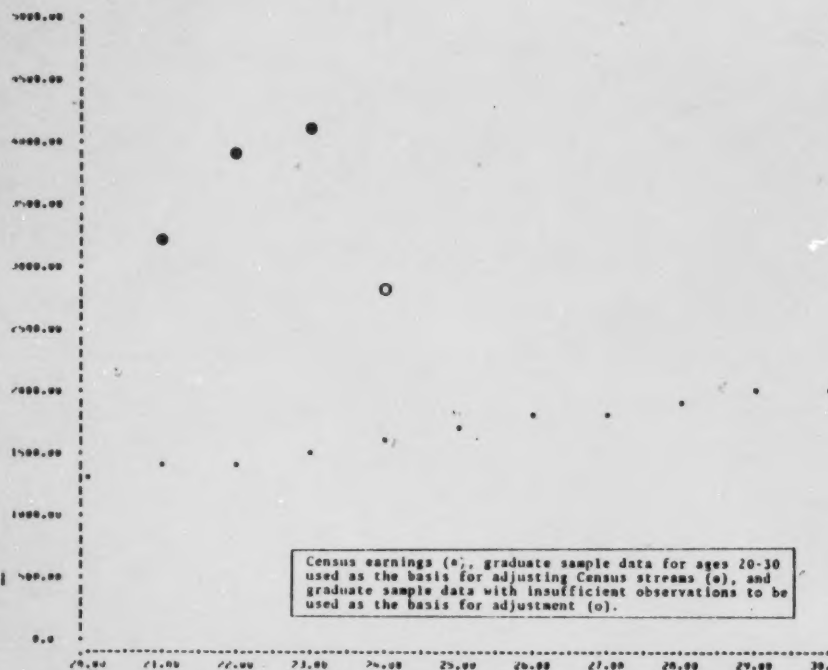


EXHIBIT T.2: GRADUATE EARNINGS OF THE BUSINESS FEMALE NON-CO-OP 2-YEAR COHORT

BUSINESS FEMALE NONCOOP 2-YEAR

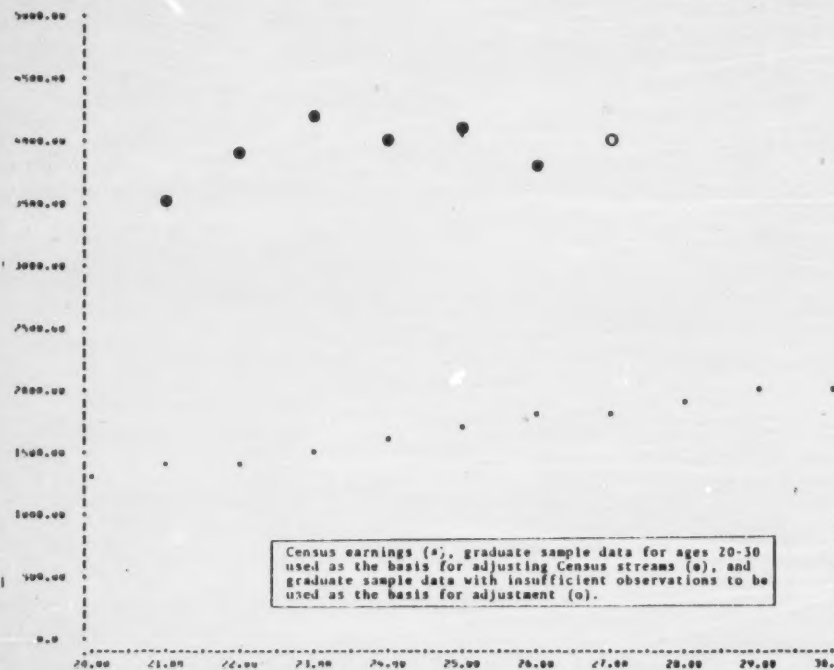
AGE	ERN	GRAD	BMFN2A	BMFN2B
20.	1314.	0.	0.	0.
21.	1409.	1514.	3804.	3604.
22.	1498.	3987.	3894.	3874.
23.	1584.	4216.	3984.	4055.
24.	1660.	4027.	4066.	4266.
25.	1743.	4105.	4145.	4467.
26.	1820.	3803.	4220.	4660.
27.	1892.	4053.	4292.	4843.
28.	1960.	0.	4360.	5018.
29.	2023.	0.	4425.	5184.
30.	2044.	0.	4486.	5341.

ALTERNATIVE ADJUSTMENTS TO CENSUS EARNINGS FOR THE COHORT - BUSINESS FEMALE NONCO-OP 2-YEAR

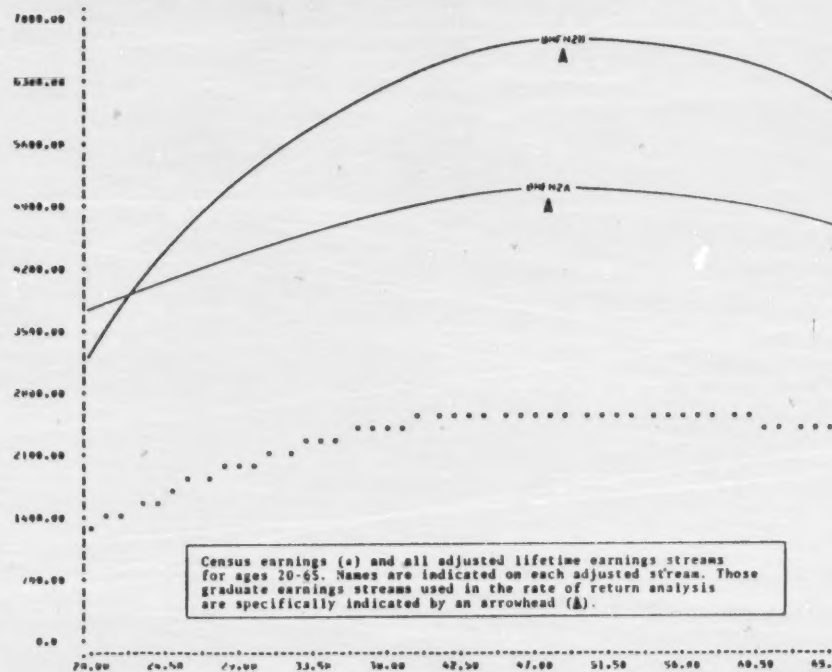
Age	Constant Difference (BMFN2A)	Constant Proportion (BMFN2B)
20	0	0
21	+ \$2400	x 2.65
22	+ \$2400	x 2.65
23	+ \$2400	x 2.65
24	+ \$2400	x 2.65
25	+ \$2400	x 2.65
26	+ \$2400	x 2.65
27	+ \$2400	x 2.65
28	+ \$2400	x 2.65
29	+ \$2400	x 2.65
30	+ \$2400	x 2.65
...	...	...
65	+ \$2400	x 2.65

Estimated Census earnings data (ERN), graduate sample data (GRAD), and all adjusted streams for ages 20-30.

Streams created by additive or multiplicative adjustment of the Census for the ages 20-65. "a" indicates a constant or varying amount added to the Census earnings data each year. "x" indicates a constant or varying factor multiplied times Census earnings. Zero earnings are specified for all years before graduation.



Census earnings (*), graduate sample data for ages 20-30 used as the basis for adjusting Census streams (a), and graduate sample data with insufficient observations to be used as the basis for adjustment (o).



Census earnings (*) and all adjusted lifetime earnings streams for ages 20-65. Names are indicated on each adjusted stream. Those graduate earnings streams used in the rate of return analysis are specifically indicated by an arrowhead (Δ).

EXHIBIT T.3: GRADUATE EARNINGS OF THE LIBERAL ARTS FEMALE CO-OP 2-YEAR COHORT

LIBERAL ARTS FEMALE COOP 2-YEAR

AGE	ERN	GRAD	LAF2A	LAF2B	LAF2C
20.	1769.	0.	0.	0.	0.
21.	1841.	2278.	3341.	2641.	2633.
22.	1911.	2732.	3411.	2711.	2733.
23.	1980.	3107.	3480.	2780.	2831.
24.	2046.	3651.	3546.	2846.	2926.
25.	2111.	4037.	3611.	2911.	3019.
26.	2174.	4117.	3674.	2974.	3109.
27.	2236.	3225.	3736.	3036.	3197.
28.	2295.	0.	3795.	3095.	3282.
29.	2351.	0.	3853.	3153.	3364.
30.	2405.	0.	3908.	3208.	3444.

Estimated Census earnings data (ERN), graduate sample data (GRAD), and all adjusted streams for ages 20-30.

ALTERNATIVE ADJUSTMENTS TO CENSUS EARNINGS FOR THE COHORT - LIBERAL ARTS FEMALE CO-OP 2-YEAR

Age	Constant Difference (LAF2A)	Constant Difference (LAF2B)	Constant Proportion (LAF2C)
20	0	0	0
21	+ \$1500	+ \$800	x 1.43
22	+ \$1500	+ \$800	x 1.43
23	+ \$1500	+ \$800	x 1.43
24	+ \$1500	+ \$800	x 1.43
25	+ \$1500	+ \$800	x 1.43
26	+ \$1500	+ \$800	x 1.43
27	+ \$1500	+ \$800	x 1.43
28	+ \$1500	+ \$800	x 1.43
29	+ \$1500	+ \$800	x 1.43
30	+ \$1500	+ \$800	x 1.43
...	...	...	...
65	+ \$1500	+ \$800	x 1.43

Streams created by additive or multiplicative adjustment of the Census for the ages 20-65. "+" indicates a constant or varying amount added to the Census earnings data each year. "x" indicates a constant or varying factor multiplied times Census earnings. Zero earnings are specified for all years before graduation.

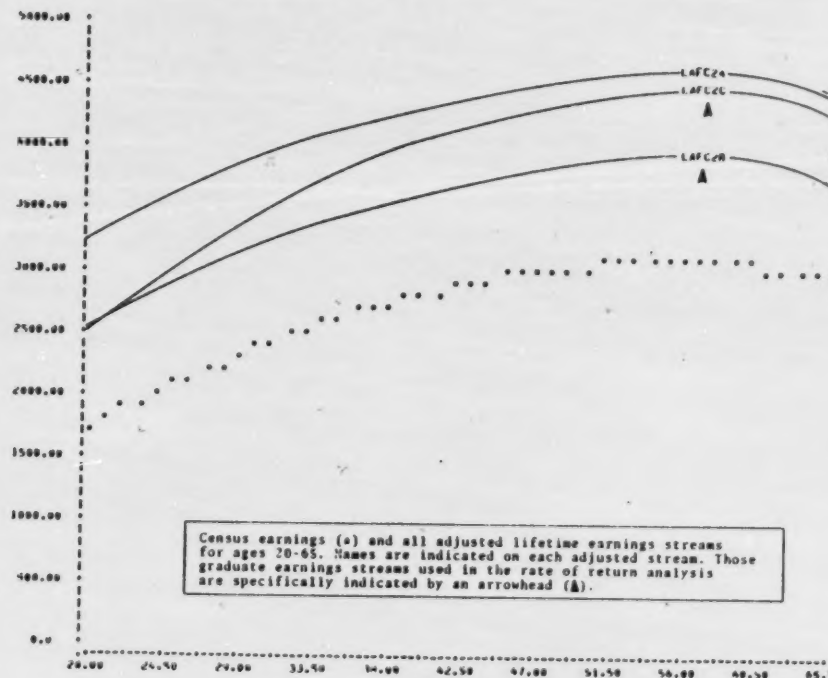
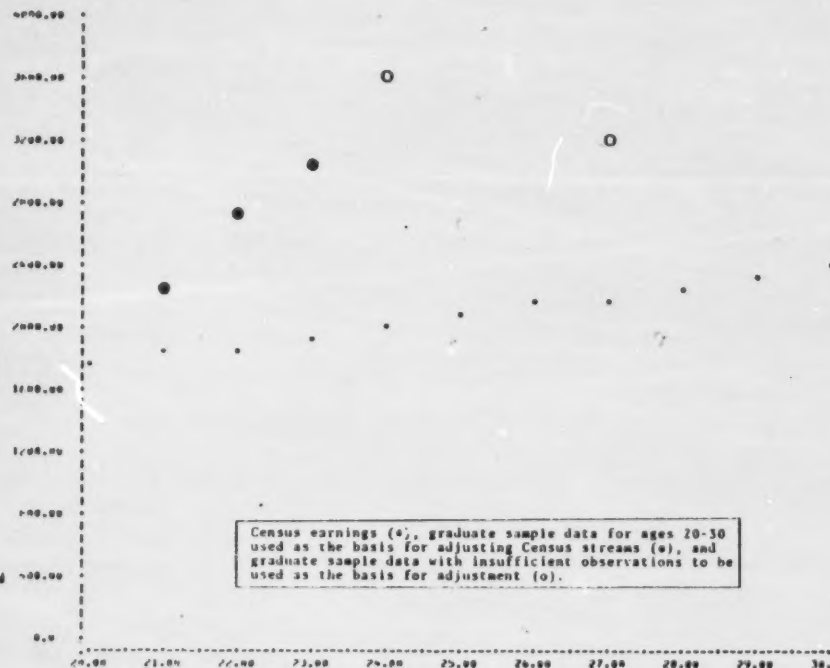


EXHIBIT T.4: GRADUATE EARNINGS OF THE LIBERAL ARTS FEMALE NON-CO-OP 2-YEAR COHORT

LIBERAL ARTS FEMALE NONCOOP 2-YEAR

AGE	ERN	GRAD	LAFN2A	LAFN2B	LAFN2C	LAFN2D
20.	1769.	0.	0.	0.	0.	0.
21.	1841.	1631.	3041.	2891.	1631.	2725.
22.	1911.	2304.	3111.	3001.	2313.	2829.
23.	1980.	3116.	3180.	3103.	3108.	2930.
24.	2045.	3453.	3246.	3213.	3458.	3029.
25.	2111.	3523.	3311.	3315.	3568.	3125.
26.	2174.	4075.	3374.	3414.	3675.	3218.
27.	2230.	3955.	3436.	3510.	3778.	3309.
28.	2295.	0.	3495.	3603.	3879.	3397.
29.	2353.	0.	3553.	3694.	3976.	3482.
30.	2408.	0.	3608.	3791.	4070.	3564.

ALTERNATIVE ADJUSTMENTS TO CENSUS EARNINGS FOR THE COHORT - LIBERAL ARTS FEMALE NONCO-OP 2-YEAR

Age	Constant Difference (LAFN2A)	Constant Proportion (LAFN2B)	Varying Proportion (LAFN2C)	Varying Proportion (LAFN2D)
20	0	0	0	0
21	+ \$1200	x 1.57	x .886	x 1.48
22	+ \$1200	x 1.57	x 1.21	x 1.48
23	+ \$1200	x 1.57	x 1.57	x 1.48
24	+ \$1200	x 1.57	x 1.69	x 1.48
25	+ \$1200	x 1.57	x 1.69	x 1.48
26	+ \$1200	x 1.57	x 1.69	x 1.48
27	+ \$1200	x 1.57	x 1.69	x 1.48
28	+ \$1200	x 1.57	x 1.69	x 1.48
29	+ \$1200	x 1.57	x 1.69	x 1.48
30	+ \$1200	x 1.57	x 1.69	x 1.48
...	...	...	...	...
65	+ \$1200	x 1.57	x 1.69	x 1.48

Estimated Census earnings data (ERN), graduate sample data (GRAD), and all adjusted streams for ages 20-30.

Streams created by additive or multiplicative adjustment of the Census for the ages 20-65. "+" indicates a constant or varying amount added to the Census earnings data each year. "x" indicates a constant or varying factor multiplied times Census earnings. Zero earnings are specified for all years before graduation.

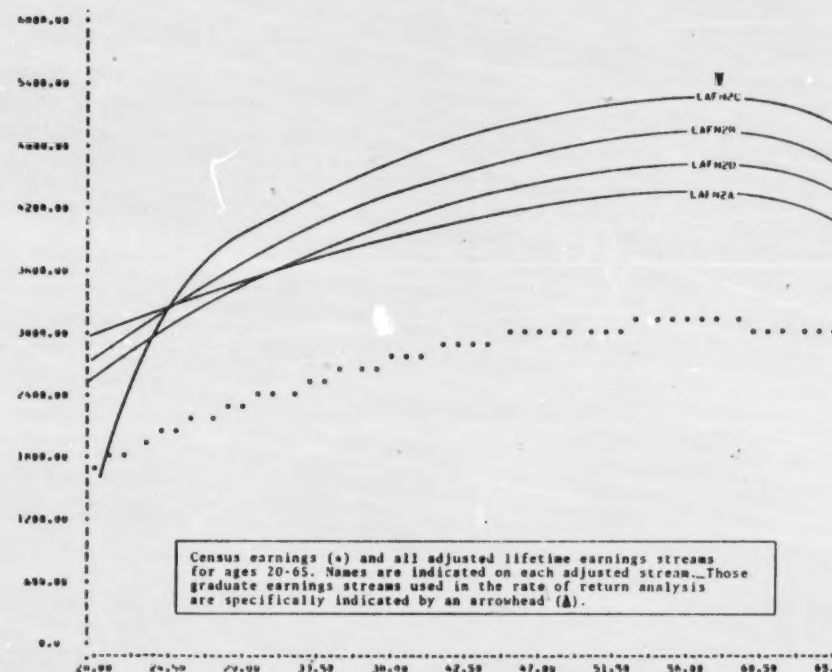
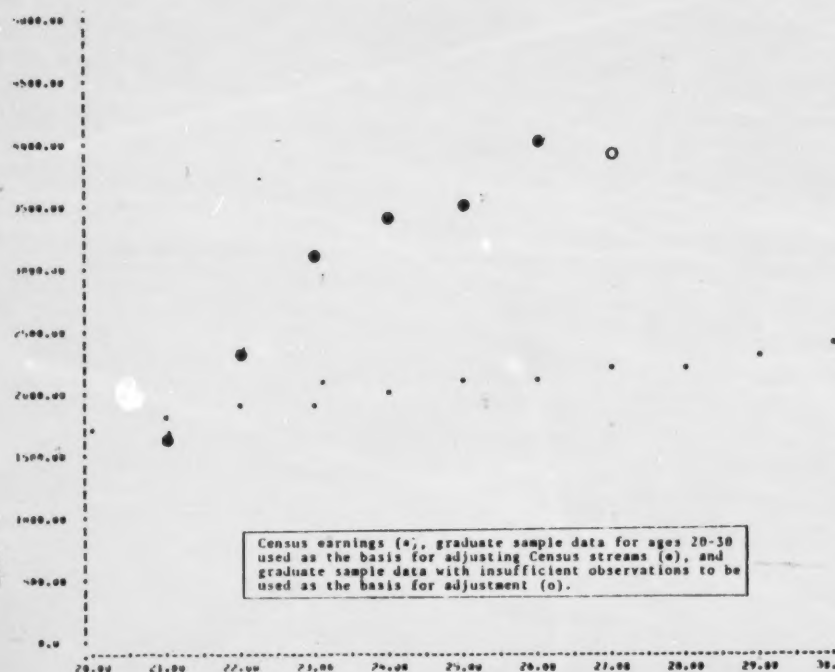


EXHIBIT T.5: GRADUATE EARNINGS OF THE HEALTH FEMALE CO-OP 2-YEAR COHORT

HEALTH FEMALE COOP 2-YEAR

AGE	ERN	GRAD	HPFC2A	HPFC2B
20.	1637.	0.	0.	0.
21.	1696.	3909.	3696.	3817.
22.	1756.	4234.	3956.	3951.
23.	1815.	3930.	4015.	4084.
24.	1874.	3271.	4074.	4217.
25.	1933.	0.	4133.	4349.
26.	1991.	0.	4191.	4479.
27.	2048.	0.	4248.	4609.
28.	2105.	0.	4305.	4736.
29.	2161.	0.	4361.	4862.
30.	2216.	0.	4416.	4986.

Estimated Census earnings data (ERN), graduate sample data (GRAD), and all adjusted streams for ages 20-30.

ALTERNATIVE ADJUSTMENTS TO CENSUS EARNINGS FOR THE COHORT - HEALTH FEMALE CO-OP 2-YEAR

Age	Constant Difference (HPFC2A)	Constant Proportion (HPFC2B)
20	0	0
21	+ \$2200	x 2.25
22	+ \$2200	x 2.25
23	+ \$2200	x 2.25
24	+ \$2200	x 2.25
25	+ \$2200	x 2.25
26	+ \$2200	x 2.25
27	+ \$2200	x 2.25
28	+ \$2200	x 2.25
29	+ \$2200	x 2.25
30	+ \$2200	x 2.25
...	...	...
65	+ \$2200	x 2.25

Streams created by additive or multiplicative adjustment of the Census for the ages 20-65. "+" indicates a constant or varying amount added to the Census earnings data each year. "x" indicates a constant or varying factor multiplied times Census earnings. Zero earnings are specified for all years before graduation.

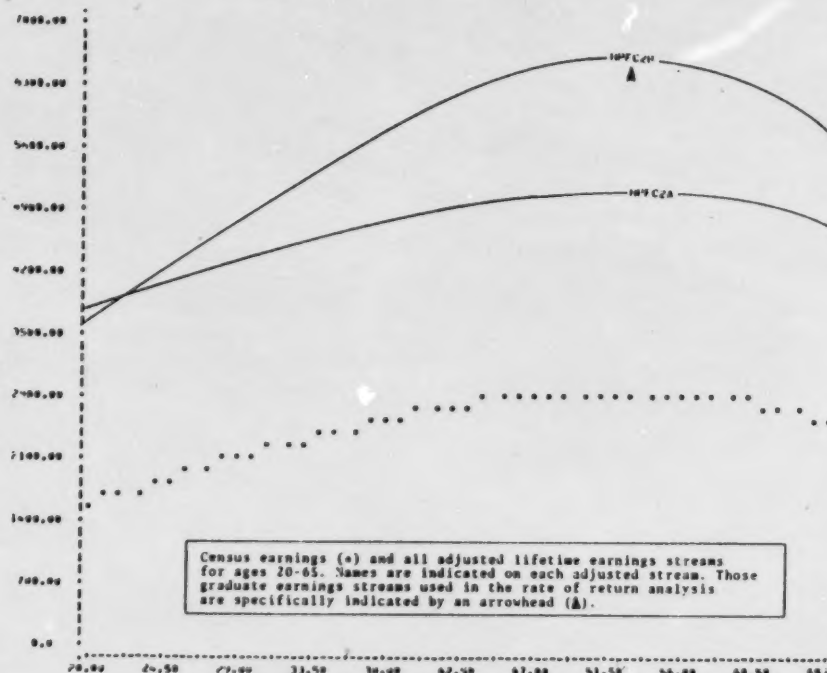
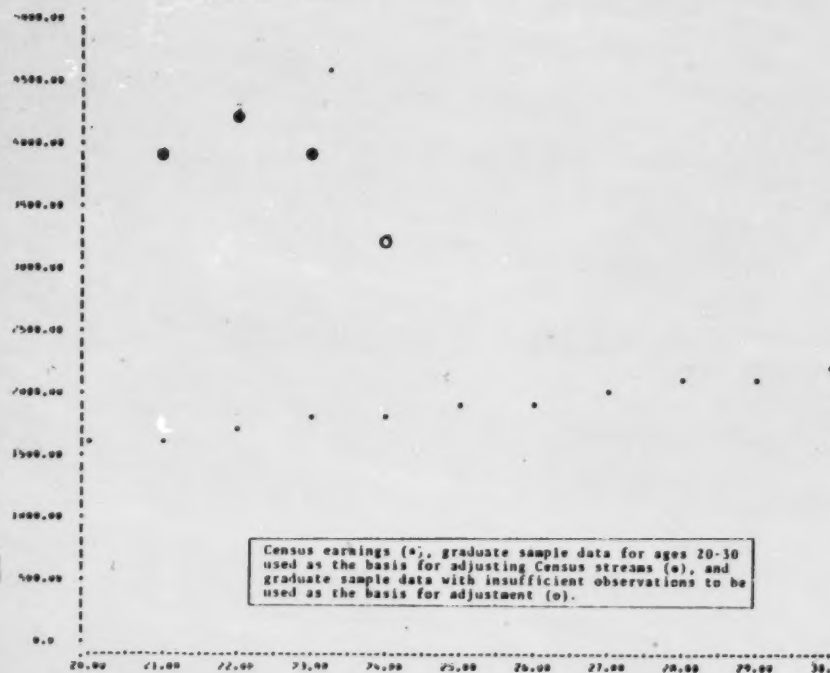
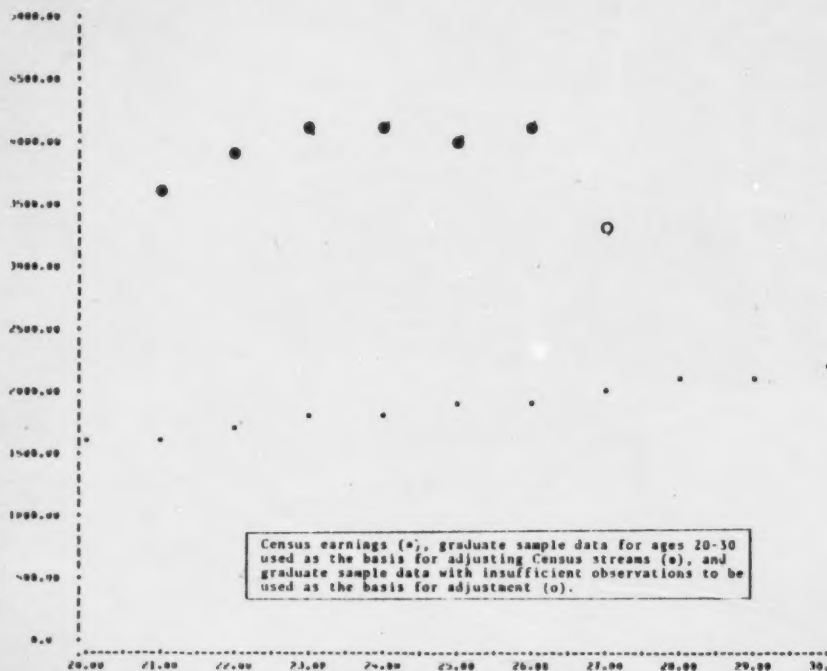


EXHIBIT T.6: GRADUATE EARNINGS OF THE HEALTH FEMALE NON-CO-OP 2-YEAR COHORT

HEALTH FEMALE NONCOOP 2-YEAR

AGE	ERN	GRAD	HPFN2A	HPFN2B	HPFN2C	HPFN2D
20.	1637.	0.	0.	0.	0.	0.
21.	1696.	3633.	3796.	3647.	3630.	3630.
22.	1750.	3984.	3856.	3775.	3986.	3986.
23.	1815.	4133.	3915.	3902.	4138.	4138.
24.	1874.	4127.	3974.	4029.	4273.	4123.
25.	1933.	4048.	4033.	4155.	4407.	4039.
26.	1991.	4163.	4091.	4280.	4539.	4161.
27.	2048.	3320.	4148.	4404.	4670.	4281.
28.	2103.	0.	4205.	4526.	4800.	4400.
29.	2161.	0.	4261.	4646.	4927.	4516.
30.	2215.	0.	4316.	4764.	5052.	4631.

Estimated Census earnings data (ERN), graduate sample data (GRAD), and all adjusted streams for ages 20-30.



ALTERNATIVE ADJUSTMENTS TO CENSUS EARNINGS FOR THE COHORT - HEALTH FEMALE NONCO-OP 2-YEAR

Age	Constant Difference (HPFN2A)	Constant Proportion (HPFN2B)	Varying Proportion (HPFN2C)	Varying Proportion (HPFN2D)
20	0	0	0	0
21	+ \$2100	x 2.15	x 2.14	x 2.14
22	+ \$2100	x 2.15	x 2.27	x 2.27
23	+ \$2100	x 2.15	x 2.28	x 2.28
24	+ \$2100	x 2.15	x 2.28	x 2.28
25	+ \$2100	x 2.15	x 2.28	x 2.09
26	+ \$2100	x 2.15	x 2.28	x 2.09
27	+ \$2100	x 2.15	x 2.28	x 2.09
28	+ \$2100	x 2.15	x 2.28	x 2.09
29	+ \$2100	x 2.15	x 2.28	x 2.09
30	+ \$2100	x 2.15	x 2.28	x 2.09
...	...	...	...	...
65	+ \$2100	x 2.15	x 2.28	x 2.09

Streams created by additive or multiplicative adjustment of the Census for the ages 20-65. "+" indicates a constant or varying amount added to the Census earnings data each year. "x" indicates a constant or varying factor multiplied times Census earnings. Zero earnings are specified for all years before graduation.

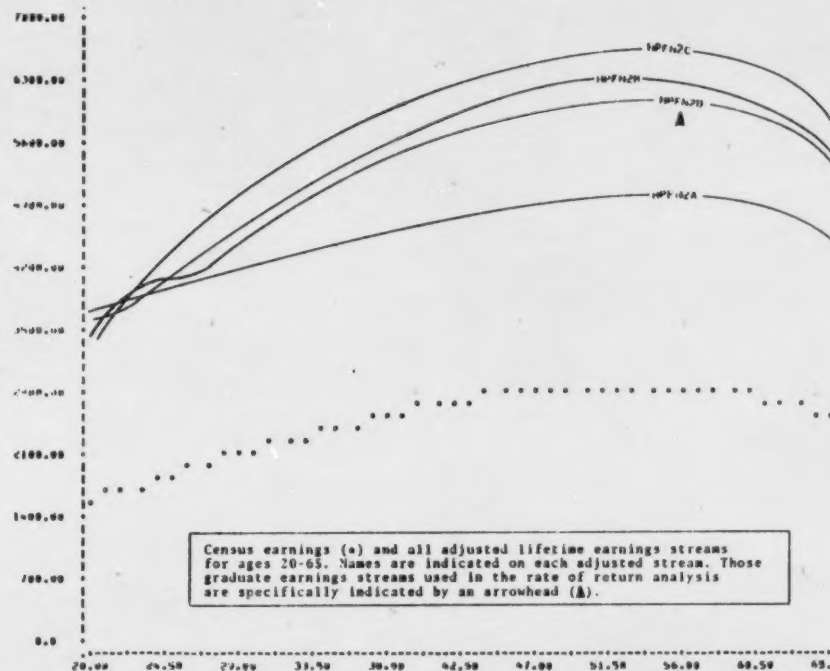


EXHIBIT T.7: GRADUATE EARNINGS OF THE BUSINESS MALE CO-OP 2-YEAR COHORT

BUSINESS MALE COOP 2-YEAR

AGE	ERN	GRAD	BMHC2A	BMHC2H
20.	149.	0.	0.	0.
21.	1747.	3505.	3397.	2695.
22.	2188.	4164.	4388.	4142.
23.	3124.	5516.	5324.	5586.
24.	4401.	5414.	6207.	6910.
25.	5437.	5870.	7037.	8156.
26.	6216.	6077.	7816.	9324.
27.	6445.	6913.	8545.	10418.
28.	7626.	0.	9226.	11439.
29.	8259.	0.	9859.	12389.
30.	8847.	0.	10446.	13269.

Estimated Census earnings data (ERN), graduate sample data (GRAD), and all adjusted streams for ages 20-30.

ALTERNATIVE ADJUSTMENTS TO CENSUS EARNINGS FOR THE COHORT - BUSINESS MALE CO-OP 2-YEAR

Age	Constant Difference (BMHC2A)	Constant Proportion (BMHC2H)
20	0	0
21	+ \$1600	x 1.50
22	+ \$1600	x 1.50
23	+ \$1600	x 1.50
24	+ \$1600	x 1.50
25	+ \$1600	x 1.50
26	+ \$1600	x 1.50
27	+ \$1600	x 1.50
28	+ \$1600	x 1.50
29	+ \$1600	x 1.50
30	+ \$1600	x 1.50
...	...	...
65	+ \$1600	x 1.50

Streams created by additive or multiplicative adjustment of the Census for the ages 20-65. "+" indicates a constant or varying amount added to the Census earnings data each year. "x" indicates a constant or varying factor multiplied times Census earnings. Zero earnings are specified for all years before graduation.

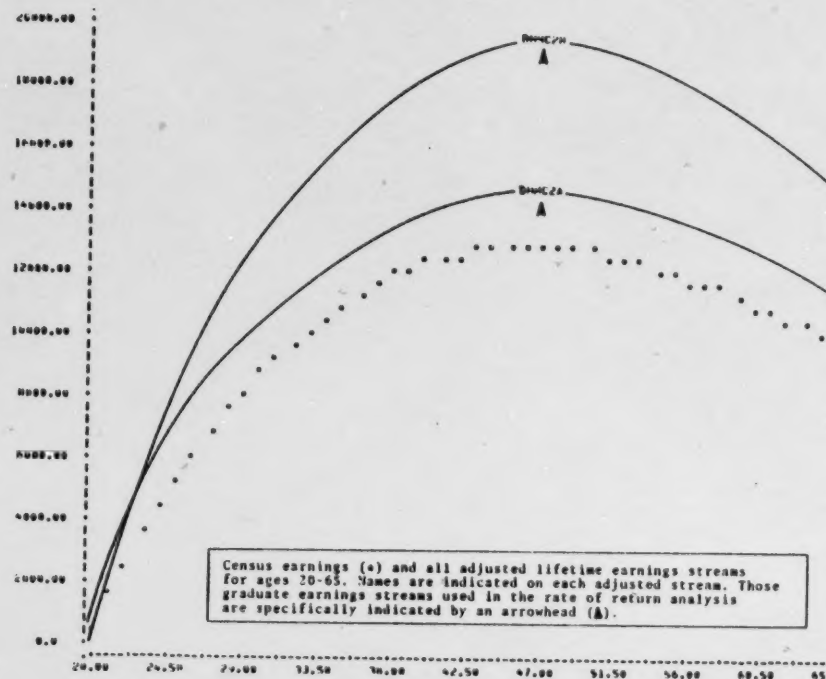
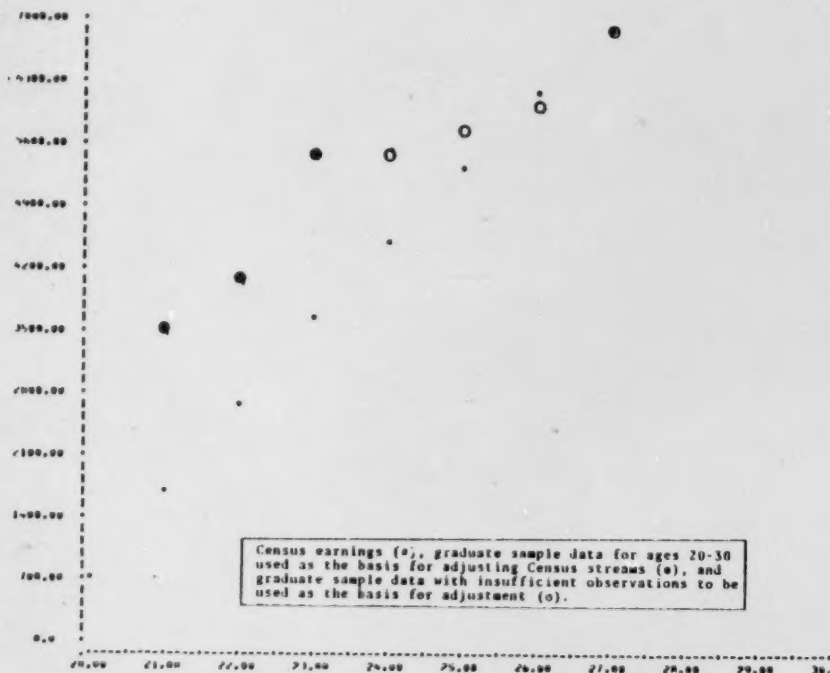


EXHIBIT T.8: GRADUATE EARNINGS OF THE BUSINESS MALE NON-CO-OP 2-YEAR COHORT

BUSINESS MALE NONCOOP 2-YEAR

AGE	ERN	GRAD	HHH2A	HHH2B
20.	144.	0.	0.	0.
21.	174.	2981.	2497.	2156.
22.	214.	3434.	3444.	3345.
23.	314.	4937.	4424.	4449.
24.	4607.	5807.	5807.	5528.
25.	5437.	6454.	6637.	6524.
26.	6210.	7280.	7416.	7459.
27.	6947.	7365.	8145.	8334.
28.	7620.	0.	8424.	9151.
29.	8254.	0.	9454.	9911.
30.	8847.	0.	10046.	10615.

Estimated Census earnings data (ERN), graduate sample data (GRAD), and all adjusted streams for ages 20-30.

ALTERNATIVE ADJUSTMENTS TO CENSUS EARNINGS FOR THE COHORT - BUSINESS MALE NONCO-OP 2-YEAR

Age	Constant Difference (BHH2A)	Constant Proportion (BHH2B)
20	0	0
21	+ \$1200	x 1.20
22	+ \$1200	x 1.20
23	+ \$1200	x 1.20
24	+ \$1200	x 1.20
25	+ \$1200	x 1.20
26	+ \$1200	x 1.20
27	+ \$1200	x 1.20
28	+ \$1200	x 1.20
29	+ \$1200	x 1.20
30	+ \$1200	x 1.20
...	...	...
65	+ \$1200	x 1.20

Streams created by additive or multiplicative adjustment of the Census for the ages 20-65. "+" indicates a constant or varying amount added to the Census earnings data each year. "x" indicates a constant or varying factor multiplied times Census earnings. Zero earnings are specified for all years before graduation.

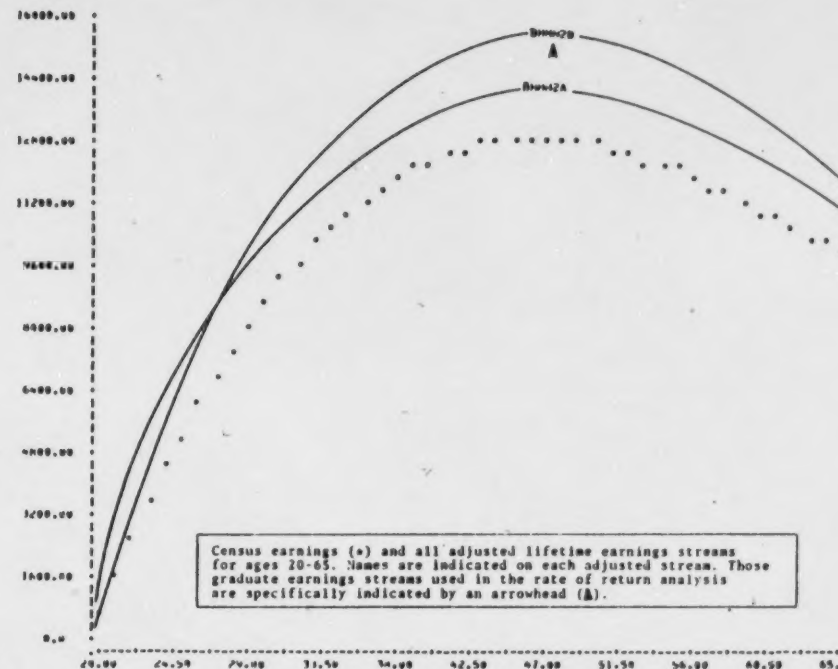
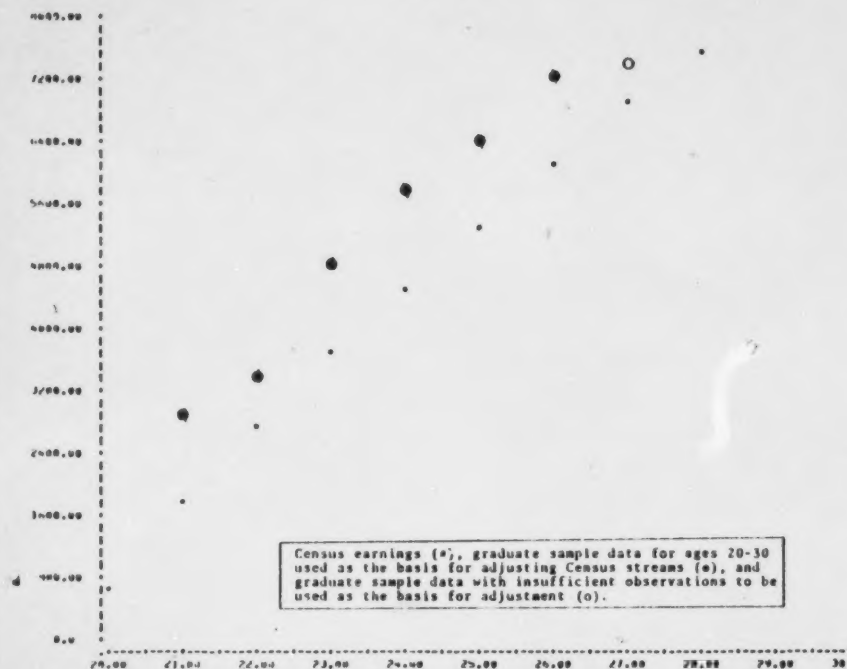
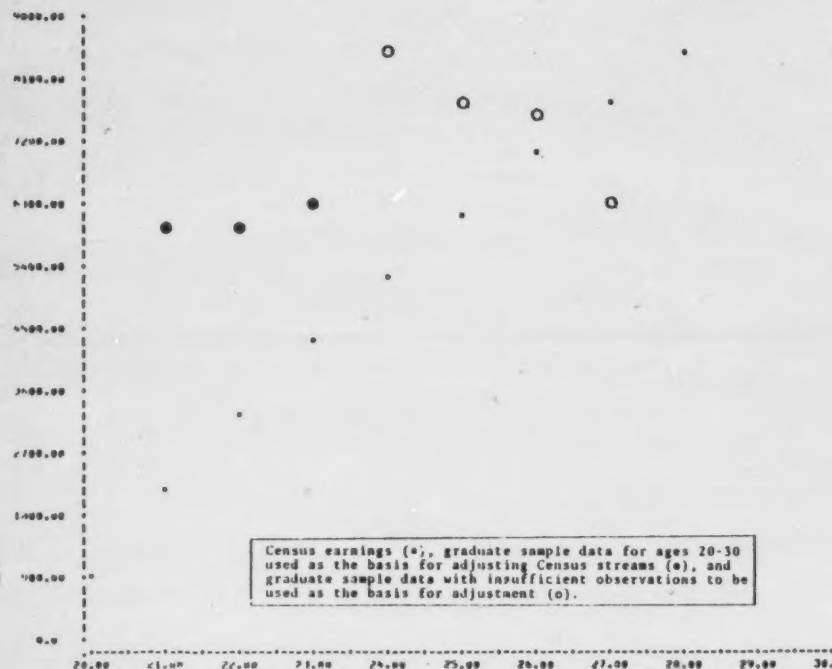


EXHIBIT T.9: GRADUATE EARNINGS OF THE ENGINEERING MALE CO-OP 2-YEAR COHORT

ENGINEERING MALE COOP 2-YEAR

AGE	ERN	GRAD	EAMC2A	EAMC2B	EAMC2C
20.	1015.	0.	0.	0.	0.
21.	2230.	5940.	4230.	4710.	5933.
22.	3363.	5950.	5363.	5863.	5953.
23.	4417.	6322.	6417.	6917.	6316.
24.	5393.	8612.	7393.	7693.	6525.
25.	6295.	7822.	8295.	8195.	6736.
26.	7175.	7692.	9125.	9675.	7268.
27.	7887.	6405.	9887.	10387.	7887.
28.	8581.	0.	10581.	11081.	8581.
29.	9212.	0.	11212.	11712.	9212.
30.	9782.	0.	11782.	12282.	9782.

Estimated Census earnings data (ERN), graduate sample data (GRAD), and all adjusted streams for ages 20-30.



ALTERNATIVE ADJUSTMENTS TO CENSUS EARNINGS FOR THE COHORT - ENGINEERING MALE CO-OP 2-YEAR

Age	Constant Difference (EAMC1A)	Constant Difference (EAMC1B)	Varying Proportion (EAMC1C)
20	0	0	0
21	+ \$2000	+ \$2500	x 2.66
22	+ \$2000	+ \$2500	x 1.77
23	+ \$2000	+ \$2500	x 1.43
24	+ \$2000	+ \$2500	x 1.21
25	+ \$2000	+ \$2500	x 1.07
26	+ \$2000	+ \$2500	x 1.02
27	+ \$2000	+ \$2500	x 1.00
28	+ \$2000	+ \$2500	x 1.00
29	+ \$2000	+ \$2500	x 1.00
30	+ \$2000	+ \$2500	x 1.00
...	...	...	...
65	+ \$2000	+ \$2500	x 1.00

Streams created by additive or multiplicative adjustment of the Census for the ages 20-65. "+" indicates a constant or varying amount added to the Census earnings data each year. "x" indicates a constant or varying factor multiplied times Census earnings. Zero earnings are specified for all years before graduation.

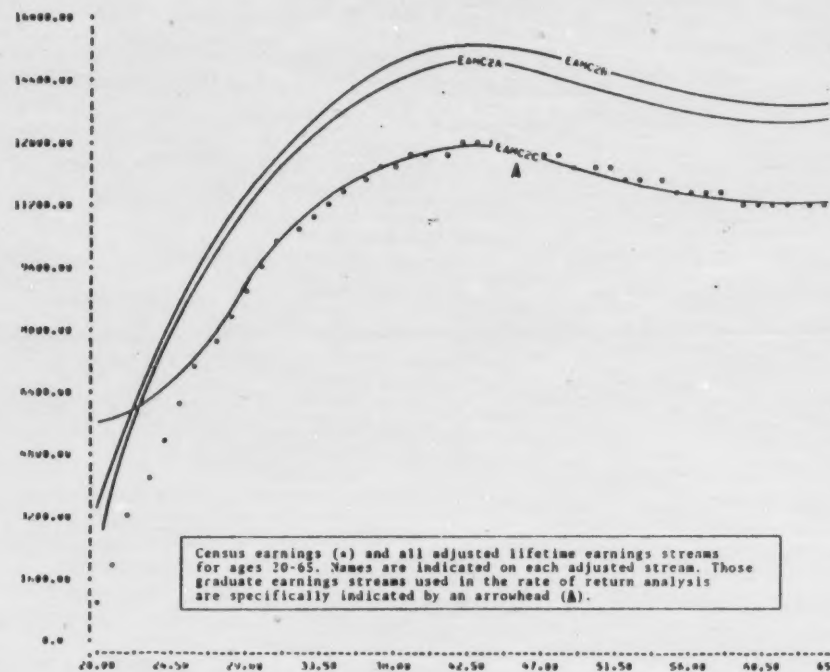


EXHIBIT T.10 GRADUATE EARNINGS OF THE ENGINEERING MALE NON-CO-OP 2-YEAR COHORT

ENGINEERING MALE NONCOOP 2-YEAR

AGE FRI GRAD EAMN2A

20.	1015.	0.	0.
21.	2230.	4410.	4430.
22.	3363.	5961.	5963.
23.	4417.	7013.	7017.
24.	5393.	7795.	7993.
25.	6295.	8313.	8895.
26.	7125.	0.	9725.
27.	7887.	0.	10487.
28.	8581.	0.	11181.
29.	9212.	0.	11812.
30.	9782.	0.	12382.

Estimated Census earnings data (ERN), graduate sample data (GRAD), and all adjusted streams for ages 20-30.

ALTERNATIVE ADJUSTMENTS TO CENSUS EARNINGS FOR THE COHORT - ENGINEERING MALE NONCO-OP 2-YEAR

Age	Constant Difference (EAMN2A)
20	0
21	+ \$2600
22	+ \$2600
23	+ \$2600
24	+ \$2600
25	+ \$2600
26	+ \$2600
27	+ \$2600
28	+ \$2600
29	+ \$2600
30	+ \$2600
...	...
45	+ \$2600

Streams created by additive or multiplicative adjustment of the Census for the ages 20-65. "o" indicates a constant or varying amount added to the Census earnings data each year. "x" indicates a constant or varying factor multiplied times Census earnings. Zero earnings are specified for all years before graduation.

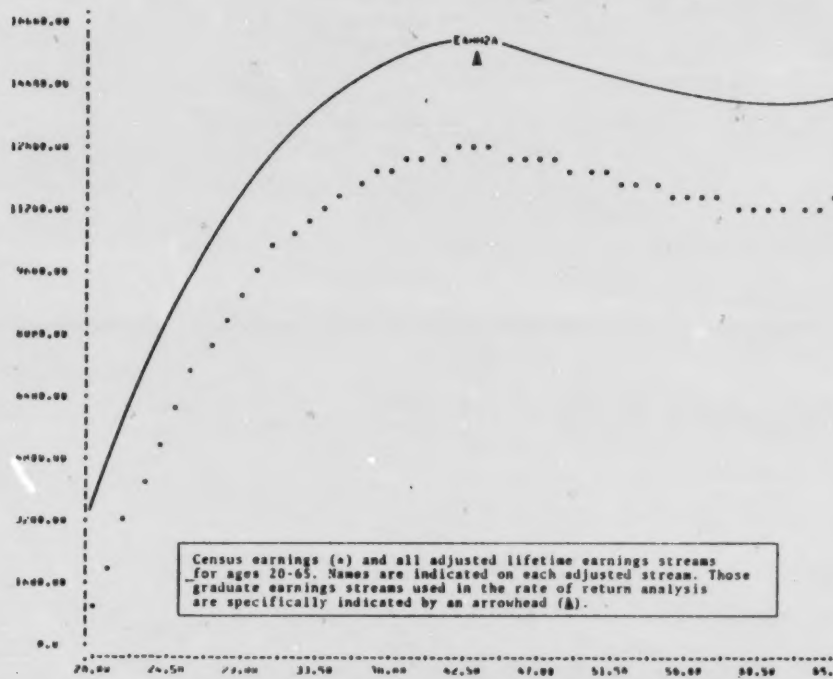
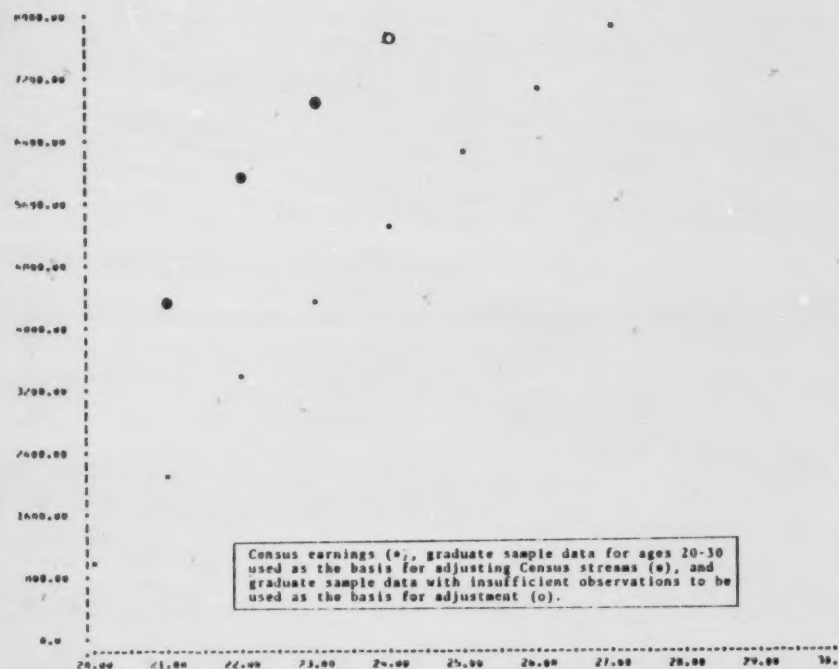


EXHIBIT T.11; GRADUATE EARNINGS OF THE LIBERAL ARTS MALE CO-OP 2-YEAR COHORT

LIBERAL ARTS MALE COOP 2-YEAR

AGE	ERN	GRAD	LAMC2A	LAMC2B	LAMC2C
20.	916.	0.	0.	0.	0.
21.	1944.	3470.	2564.	3064.	3477.
22.	2945.	3631.	3546.	4046.	3623.
23.	3862.	3846.	4462.	4962.	3862.
24.	4715.	1713.	5315.	5815.	4715.
25.	5597.	0.	6107.	6607.	5507.
26.	6240.	0.	6640.	7340.	6240.
27.	6915.	0.	7515.	8015.	6915.
28.	7535.	0.	8135.	8635.	7535.
29.	8101.	0.	8701.	9201.	8101.
30.	8616.	0.	9216.	9716.	8616.

Estimated Census earnings data (ERN), graduate sample data (GRAD), and all adjusted streams for ages 20-30.

ALTERNATIVE ADJUSTMENTS TO CENSUS EARNINGS FOR THE COHORT - LIBERAL ARTS MALE CO-OP 2-YEAR

Age	Constant Difference (LAMC2A)	Constant Difference (LAMC2B)	Varying Proportion (LAMC2C)
20	0	0	0
21	+ \$600	+ \$1100	x 1.77
22	+ \$600	+ \$1100	x 1.23
23	+ \$600	+ \$1100	x 1.00
24	+ \$600	+ \$1100	x 1.00
25	+ \$600	+ \$1100	x 1.00
26	+ \$600	+ \$1100	x 1.00
27	+ \$600	+ \$1100	x 1.00
28	+ \$600	+ \$1100	x 1.00
29	+ \$600	+ \$1100	x 1.00
30	+ \$600	+ \$1100	x 1.00
...	...	...	...
65	+ \$600	+ \$1100	x 1.00

Streams created by additive or multiplicative adjustment of the Census for the ages 20-65. "+" indicates a constant or varying amount added to the Census earnings data each year. "x" indicates a constant or varying factor multiplied times Census earnings. Zero earnings are specified for all years before graduation.

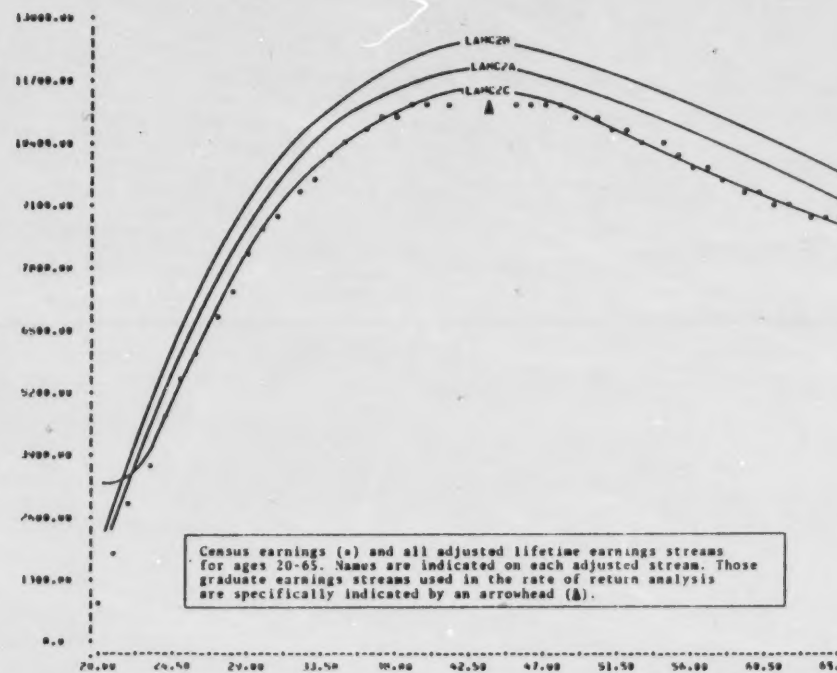
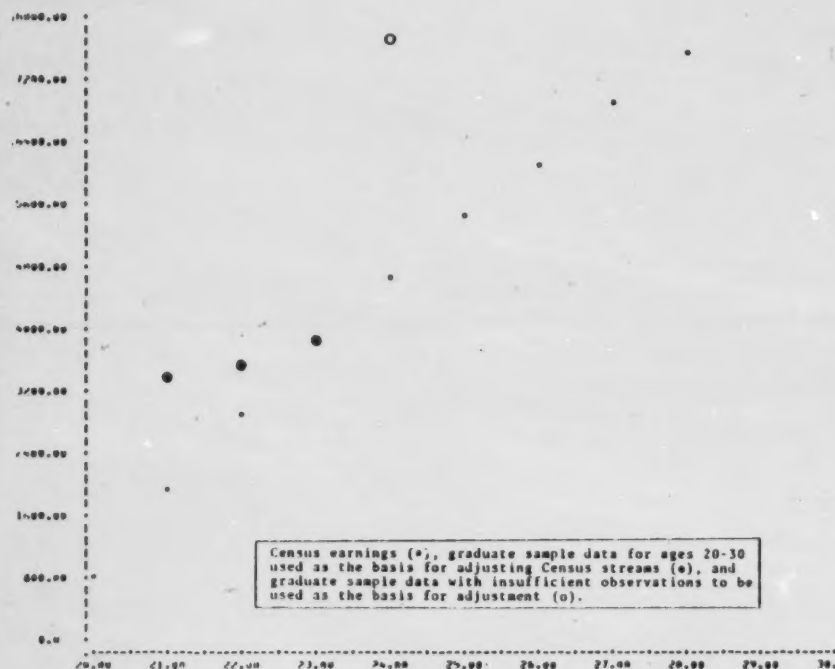


EXHIBIT T.12: GRADUATE EARNINGS OF THE LIBERAL ARTS MALE NON-CO-OP 2-YEAR COHORT

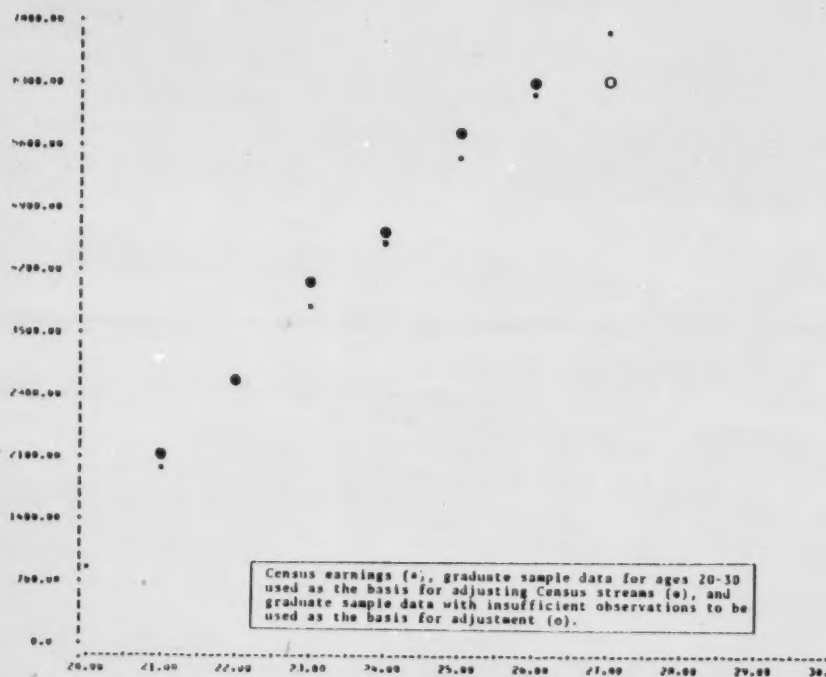
LIBERAL ARTS MALE NONCOOP 2-YEAR

AGE	ERN	GRAD	LAMN2A
20.	916.	0.	0.
21.	1964.	2230.	1964.
22.	2946.	2946.	2946.
23.	3862.	4125.	3862.
24.	4715.	4510.	4715.
25.	5507.	5843.	5507.
26.	6240.	6411.	6240.
27.	6915.	6383.	6915.
28.	7535.	0.	7535.
29.	8101.	0.	8101.
30.	8616.	0.	8616.

ALTERNATIVE ADJUSTMENTS TO CENSUS EARNINGS FOR THE COHORT - LIBERAL ARTS MALE NONCO-OP 2-YEAR

Age	Constant Proportion (LAMN2A)
20	0
21	x 1.00
22	x 1.00
23	x 1.00
24	x 1.00
25	x 1.00
26	x 1.00
27	x 1.00
28	x 1.00
29	x 1.00
30	x 1.00
...	...
65	x 1.00

Estimated Census earnings data (ERN), graduate sample data (GRAD), and all adjusted streams for ages 20-30.



Streams created by additive or multiplicative adjustment of the Census for the ages 20-65. "0" indicates a constant or varying amount added to the Census earnings data each year. "x" indicates a constant or varying factor multiplied times Census earnings. Zero earnings are specified for all years before graduation.

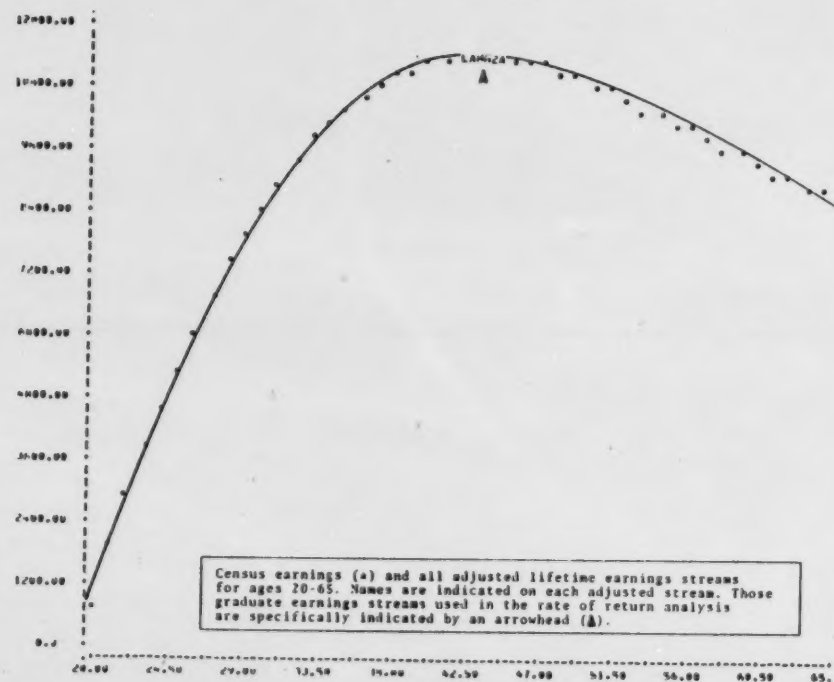


EXHIBIT T.13. GRADUATE EARNINGS OF THE TRADE AND INDUSTRIAL MALE NON-CO-OP 2-YEAR COHORT.

TRADE AND INDUSTRIAL MALE NON-CO-OP 2-YEAR

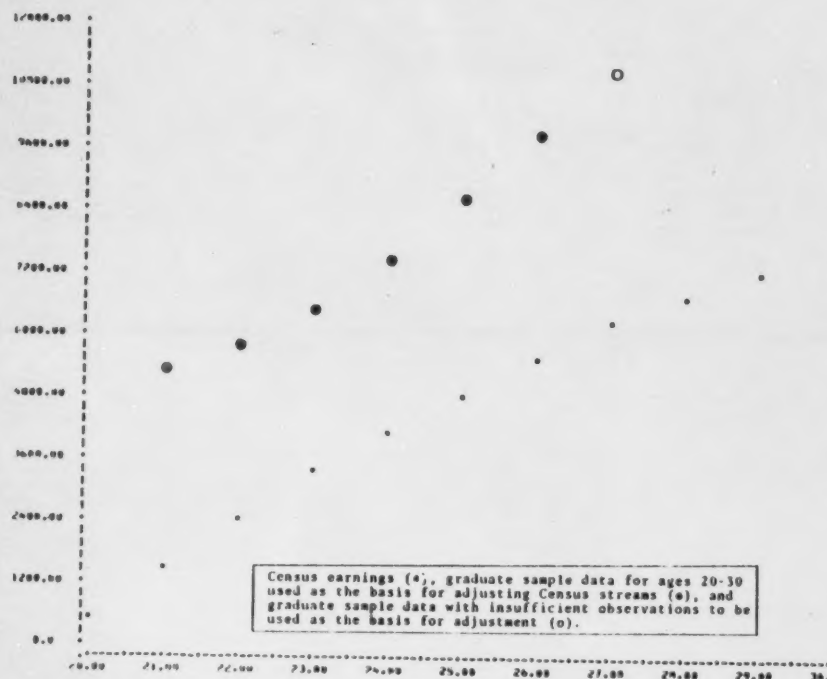
AGE	ERN	GRAD	TIMN2A
20.	639.	0.	0.
21.	1654.	5399.	5391.
22.	2590.	5933.	5945.
23.	3464.	6699.	6694.
24.	4273.	7651.	7650.
25.	5013.	8804.	8773.
26.	5690.	9841.	9787.
27.	6306.	11157.	10720.
28.	6861.	0.	11668.
29.	7365.	0.	12520.
30.	7812.	0.	13281.

ALTERNATIVE ADJUSTMENTS TO CENSUS EARNINGS FOR THE COHORT - TRADE AND INDUSTRIAL MALE NONCO-OP 2-YEAR

Varying Proportion (TIMN2A)

AGE	Proportion
20	0
21	x 3.26
22	x 2.29
23	x 1.93
24	x 1.79
25	x 1.75
26	x 1.72
27	x 1.70
28	x 1.70
29	x 1.70
30	x 1.70
...	...
65	x 1.70

Estimated Census earnings data (ERN), graduate sample data (GRAD), and all adjusted streams for ages 20-30.



Streams created by additive or multiplicative adjustment of the Census for the ages 20-65. "*" indicates a constant or varying amount added to the Census earnings data each year. "x" indicates a constant or varying factor multiplied times Census earnings. Zero earnings are specified for all years before graduation.

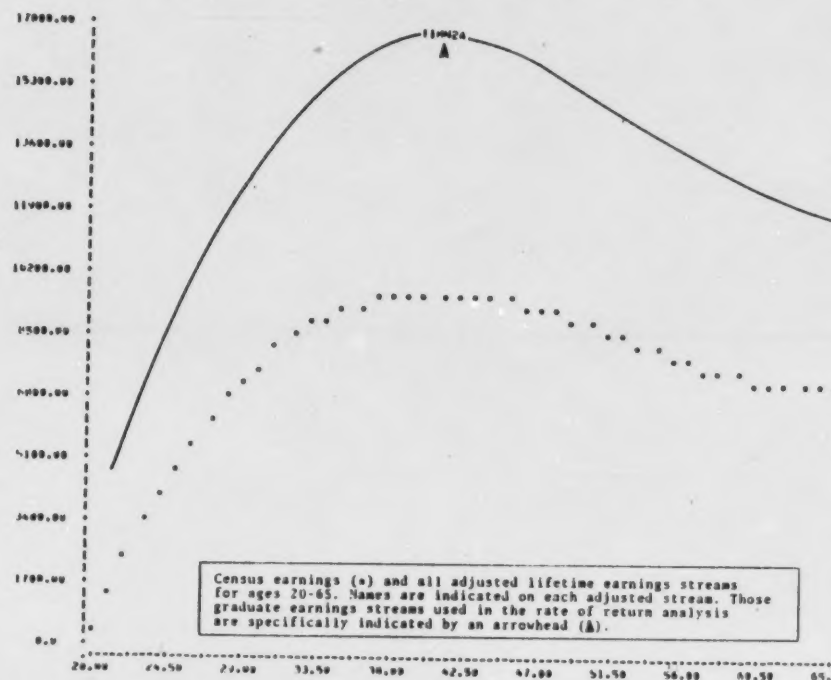
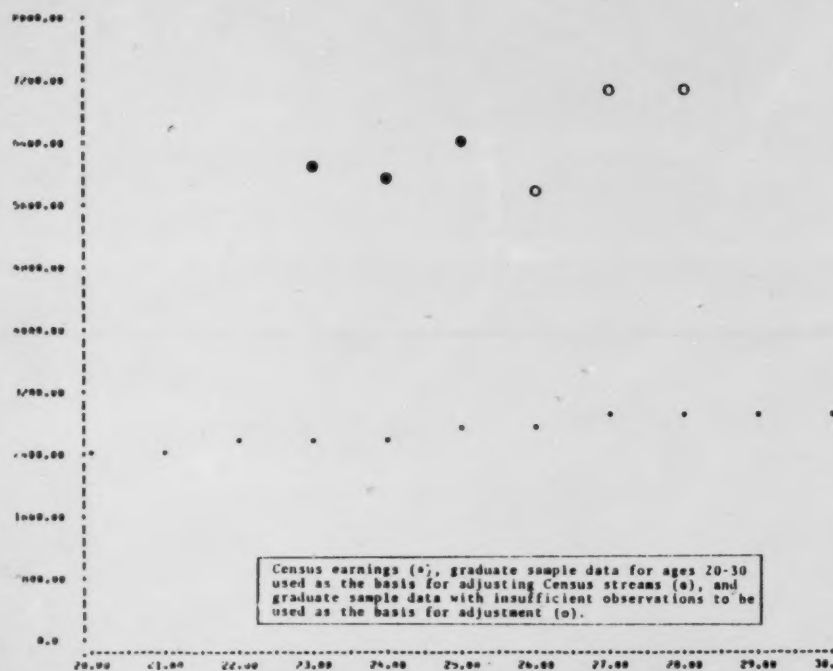


EXHIBIT T.14: GRADUATE EARNINGS OF THE BUSINESS FEMALE CO-OP 4-YEAR COHORT

BUSINESS FEMALE COOP 4-YEAR

AGE	F4N	GRAD	BMFC4A	BMFC4B
20.	2423.	0.	0.	0.
21.	2497.	0.	0.	0.
22.	2564.	0.	0.	0.
23.	2637.	6226.	6137.	6064.
24.	2702.	6049.	6202.	6214.
25.	2764.	6434.	6264.	6357.
26.	2824.	5809.	6324.	6494.
27.	2881.	7065.	6381.	6625.
28.	2935.	7121.	6435.	6751.
29.	2987.	0.	6487.	6870.
30.	3037.	0.	6537.	6984.

Estimated Census earnings data (ERN), graduate sample data (GRAD), and all adjusted streams for ages 20-30.

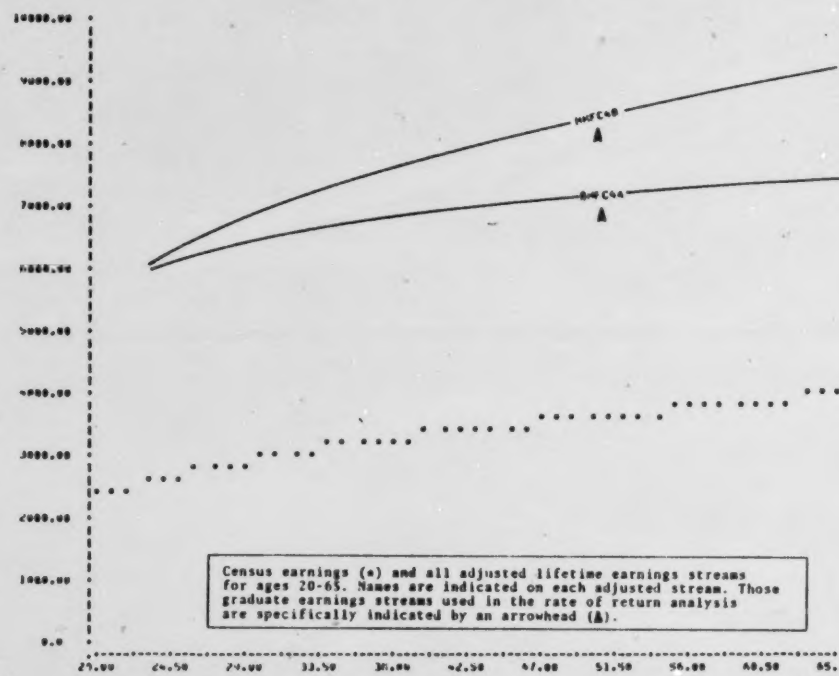


Census earnings (*), graduate sample data for ages 20-30 used as the basis for adjusting Census streams (a), and graduate sample data with insufficient observations to be used as the basis for adjustment (o).

ALTERNATIVE ADJUSTMENTS TO CENSUS EARNINGS FOR THE COHORT - BUSINESS FEMALE CO-OP 4-YEAR

Age	Constant Difference (BMFC2A)	Constant Proportion (BMFC2B)
20	0	0
21	0	0
22	0	0
23	+ \$3500	x 2.30
24	+ \$3500	x 2.30
25	+ \$3500	x 2.30
26	+ \$3500	x 2.30
27	+ \$3500	x 2.30
28	+ \$3500	x 2.30
29	+ \$3500	x 2.30
30	+ \$3500	x 2.30
...	...	...
65	+ \$3500	x 2.30

Streams created by additive or multiplicative adjustment of the Census for the ages 20-65. "+" indicates a constant or varying amount added to the Census earnings data each year. "x" indicates a constant or varying factor multiplied times Census earnings. Zero earnings are specified for all years before graduation.



Census earnings (*) and all adjusted lifetime earnings streams for ages 20-65. Names are indicated on each adjusted stream. Those graduate earnings streams used in the rate of return analysis are specifically indicated by an arrowhead (A).

EXHIBIT T.15. GRADUATE EARNINGS OF THE BUSINESS FEMALE NON-CO-OP 4-YEAR COHORT

BUSINESS FEMALE NONCOOP 4-YEAR

AGE	FMN	GM4U	HMFN4A	BMF114B	BMFN4C	BMFN4D
20.	2423.	0.	0.	0.	0.	0.
21.	2491.	0.	0.	0.	0.	0.
22.	2567.	0.	0.	0.	0.	0.
23.	2631.	3914.	4637.	4492.	3902.	3914.
24.	2702.	5020.	4702.	4593.	5025.	5020.
25.	2764.	5041.	4764.	4699.	5031.	5041.
26.	2824.	4234.	4824.	4800.	4236.	4234.
27.	2881.	3576.	4881.	4897.	3572.	3576.
28.	2937.	3490.	4937.	4990.	3493.	3490.
29.	2987.	0.	4987.	5078.	3555.	3542.
30.	3037.	0.	5037.	5162.	3614.	3592.

Estimated Census earnings data (ERN), graduate sample data (GRAD), and all adjusted streams for ages 20-30.

ALTERNATIVE ADJUSTMENTS TO CENSUS EARNINGS FOR THE COHORT - BUSINESS FEMALE NONCO-OP 4-YEAR

Age	Constant Difference (BMFN4A)	Constant Proportion (BMFN4B)	Varying Proportion (BMFN4C)	Varying Difference (BMFN4D)
20	0	0	0	0
21	0	0	0	0
22	0	0	0	0
23	+ \$2000	x 1.70	x 1.48	+ \$1277
24	+ \$2000	x 1.70	x 1.86	+ \$2318
25	+ \$2000	x 1.70	x 1.82	+ \$2277
26	+ \$2000	x 1.70	x 1.50	+ \$1410
27	+ \$2000	x 1.70	x 1.24	+ \$ 695
28	+ \$2000	x 1.70	x 1.19	+ \$ 555
29	+ \$2000	x 1.70	x 1.19	+ \$ 555
30	+ \$2000	x 1.70	x 1.19	+ \$ 555
...	...	...	...	...
65	+ \$2000	x 1.70	x 1.19	+ \$ 555

Streams created by additive or multiplicative adjustment of the Census for the ages 20-65. "+" indicates a constant or varying amount added to the Census earnings data each year. "x" indicates a constant or varying factor multiplied times Census earnings. Zero earnings are specified for all years before graduation.

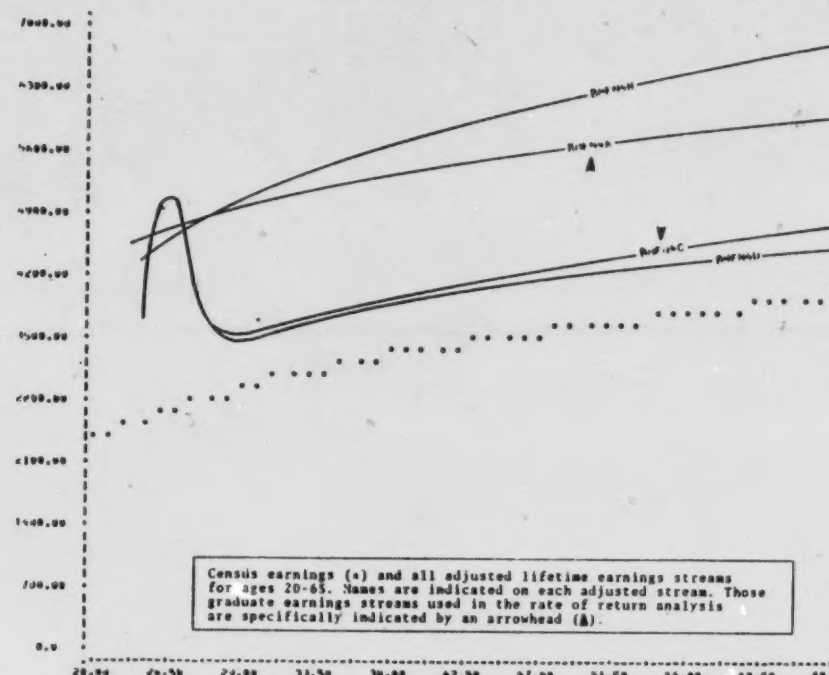
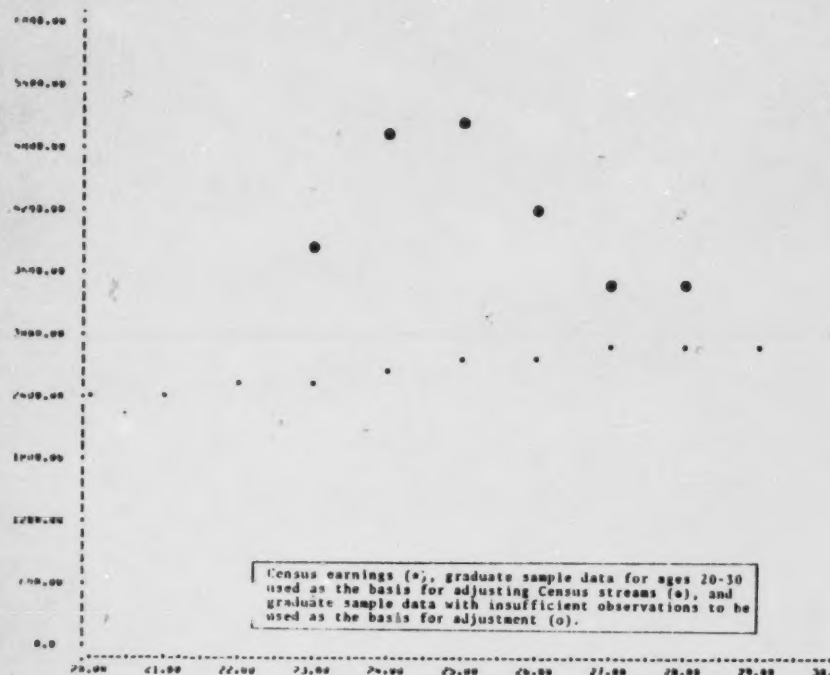


EXHIBIT T.16: GRADUATE EARNINGS OF THE HEALTH FEMALE NON-CO-OP 4-YEAR COHORT

HEALTH FEMALE NONCOOP 4-YEAR

AGE	ERN	GRAD	HPPN4A	HPPN4B
20.	3612.	0.	0.	0.
21.	3535.	0.	0.	0.
22.	3412.	0.	0.	0.
23.	3420.	5620.	7670.	7079.
24.	3379.	1244.	7629.	6994.
25.	3349.	7592.	7599.	6972.
26.	3329.	8837.	7579.	6891.
27.	3318.	1324.	7568.	6869.
28.	3317.	5042.	7567.	6865.
29.	3323.	0.	7573.	6879.
30.	3334.	0.	7588.	6909.

ALTERNATIVE ADJUSTMENTS TO CENSUS EARNINGS FOR THE COHORT - HEALTH FEMALE NONCO-OP 4-YEAR

Age	Constant Difference (HPPN4A)	Constant Proportion (HPPN4B)
20	0	0
21	0	0
22	0	0
23	+ \$4250	x 2.07
24	+ \$4250	x 2.07
25	+ \$4250	x 2.07
26	+ \$4250	x 2.07
27	+ \$4250	x 2.07
28	+ \$4250	x 2.07
29	+ \$4250	x 2.07
30	+ \$4250	x 2.07
...	...	...
65	+ \$4250	x 2.07

Estimated Census earnings data (ERN), graduate sample data (GRAD), and all adjusted streams for ages 20-30.

Streams created by additive or multiplicative adjustment of the Census for the ages 20-65. "+" indicates a constant or varying amount added to the Census earnings data each year. "x" indicates a constant or varying factor multiplied times Census earnings. Zero earnings are specified for all years before graduation.

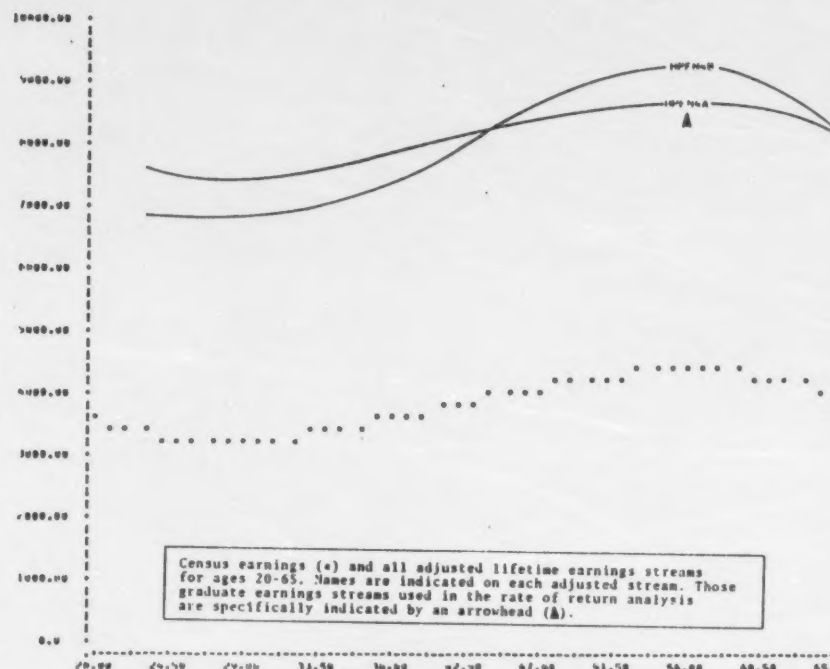
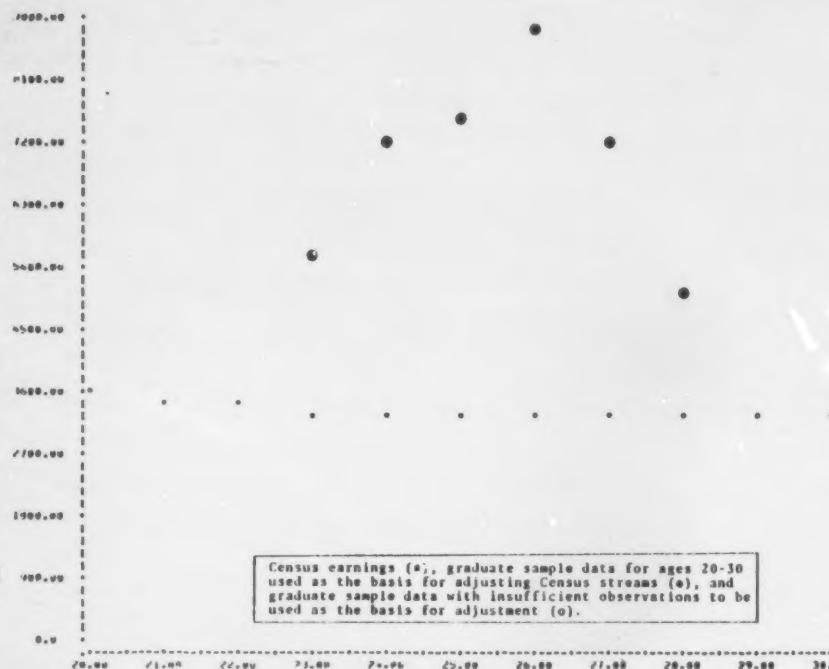


EXHIBIT T.17: GRADUATE EARNINGS OF THE LIBERAL ARTS FEMALE CO-OP 4-YEAR COHORT

LIBERAL ARTS FEMALE COOP 4-YEAR

AGE	FEM	GRAD	LAFC4A	LAFC4B	LAFC4C
20.	3205.	0.	0.	0.	0.
21.	3237.	0.	0.	0.	0.
22.	3294.	0.	0.	0.	0.
23.	3470.	4055.	4638.	4055.	4064.
24.	3450.	4669.	4813.	4669.	4659.
25.	3832.	5410.	4794.	5410.	5412.
26.	3837.	5237.	4794.	5406.	5407.
27.	3837.	3620.	4794.	5410.	5412.
28.	4649.	3883.	4611.	5420.	5427.
29.	3866.	0.	4833.	5437.	5451.
30.	3119.	0.	4862.	5460.	5484.

ALTERNATIVE ADJUSTMENTS TO CENSUS EARNINGS FOR THE COHORT - LIBERAL ARTS FEMALE CO-OP 4-YEAR

Age	Constant Proportion (LAFC4A)	Varying Difference (LAFC4B)	Varying Proportion (LAFC4C)
20	0	0	0
21	0	0	0
22	0	0	0
23	x 1.25	+ \$ 185	x 1.05
24	x 1.25	+ \$ 819	x 1.21
25	x 1.25	+ \$1571	x 1.41
26	x 1.25	+ \$1571	x 1.41
27	x 1.25	+ \$1571	x 1.41
28	x 1.25	+ \$1571	x 1.41
29	x 1.25	+ \$1571	x 1.41
30	x 1.25	+ \$1571	x 1.41
...	...	...	...
65	x 1.25	+ \$1571	x 1.41

Estimated Census earnings data (ERN), graduate sample data (GRAD), and all adjusted streams for ages 20-30.

Streams created by additive or multiplicative adjustment of the Census for the ages 20-65. "+" indicates a constant or varying amount added to the Census earnings data each year. "x" indicates a constant or varying factor multiplied times Census earnings. Zero earnings are specified for all years before graduation.

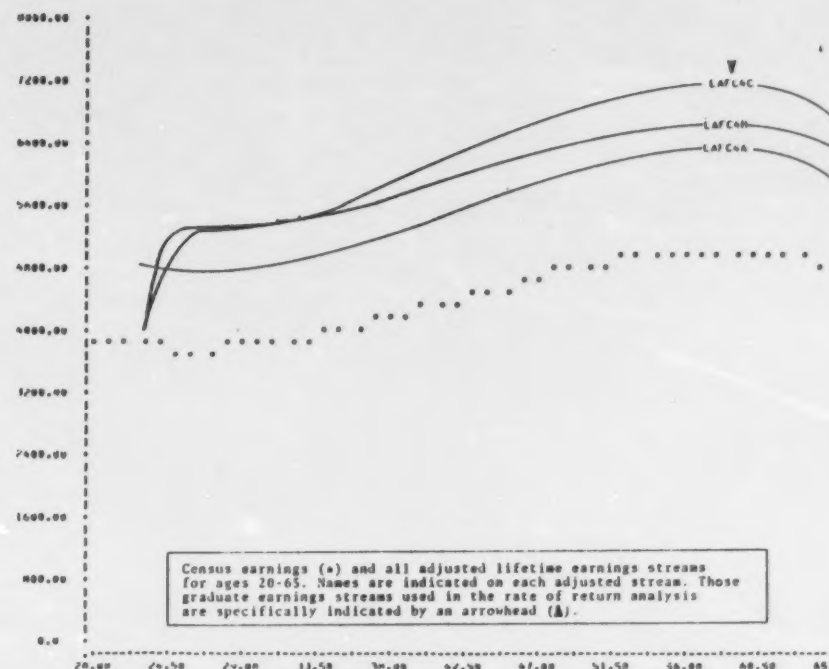
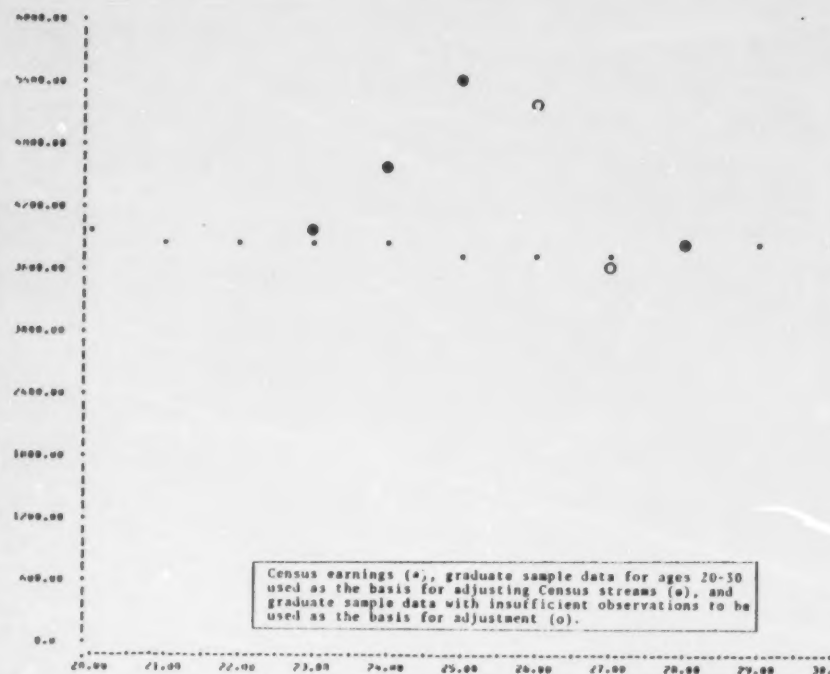


EXHIBIT T.18: GRADUATE EARNINGS OF THE LIBERAL ARTS FEMALE NON-CO-OP 4-YEAR COHORT

LIBERAL ARTS FEMALE NONCOOP 4-YEAR

AGE	ERN	GRAD	LAFN4A	LAFN4B	LAFN4C
20.	3447.	0.	0.	0.	0.
21.	3437.	0.	0.	0.	0.
22.	3447.	0.	0.	0.	0.
23.	3470.	3190.	4570.	3149.	3190.
24.	3450.	4311.	4550.	4312.	4311.
25.	3437.	4741.	4534.	4721.	4741.
26.	3435.	4890.	4535.	4709.	4890.
27.	3434.	5108.	4539.	5105.	5108.
28.	3447.	4558.	4549.	4542.	4558.
29.	3447.	3765.	4560.	4562.	4575.
30.	3447.	0.	4569.	4589.	4598.

ALTERNATIVE ADJUSTMENTS TO CENSUS EARNINGS FOR THE COHORT - LIBERAL ARTS FEMALE NONCO-OP 4-YEAR

Age	Constant Difference (LAFN4A)	Varying Proportion (LAFN4B)	Varying Difference (LAFN4C)
20	0	0	0
21	0	0	0
22	0	0	0
23	+ \$700	x .824	- \$ 680
24	+ \$700	x 1.12	+ \$ 461
25	+ \$700	x 1.23	+ \$ 902
26	+ \$700	x 1.28	+ \$1055
27	+ \$700	x 1.33	+ \$1269
28	+ \$700	x 1.18	+ \$ 709
29	+ \$700	x 1.18	+ \$ 709
30	+ \$700	x 1.18	+ \$ 709
...	...	...	...
65	+ \$700	x 1.18	+ \$ 709

Estimated Census earnings data (ERN), graduate sample data (GRAD), and all adjusted streams for ages 20-30.

Streams created by additive or multiplicative adjustment of the Census for the ages 20-65. "+" indicates a constant or varying amount added to the Census earnings data each year. "x" indicates a constant or varying factor multiplied times Census earnings. Zero earnings are specified for all years before graduation.

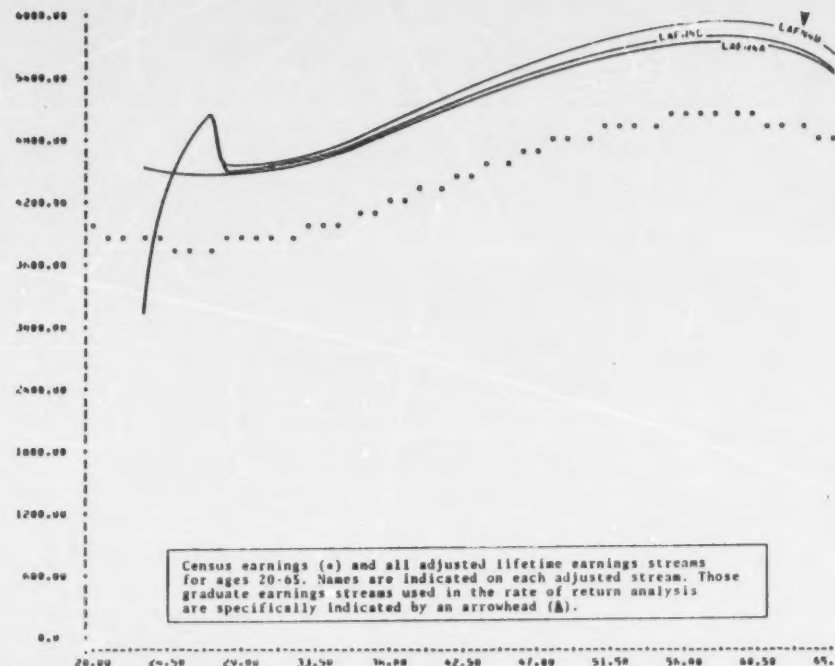
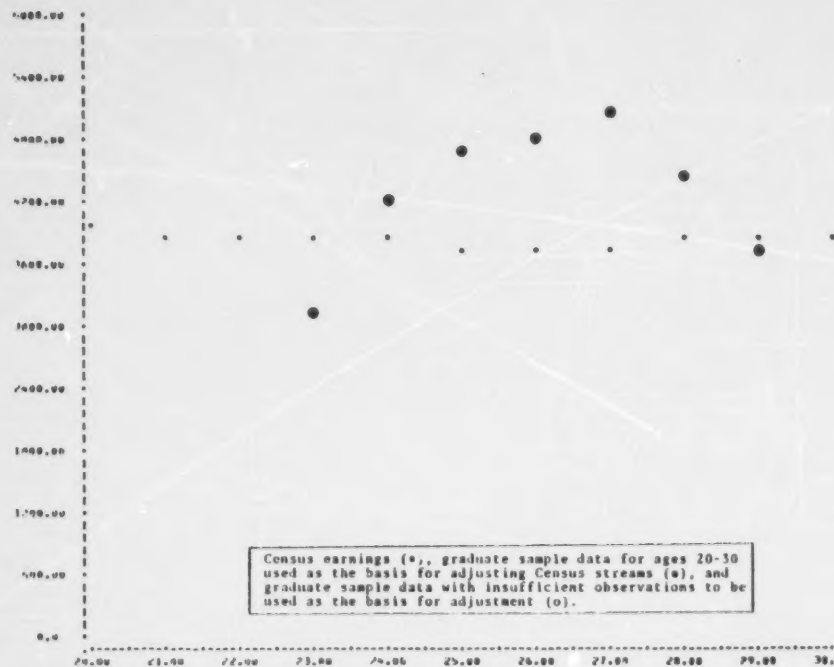


EXHIBIT T.19: GRADUATE EARNINGS OF THE BUSINESS MALE CO-OP 4-YEAR COHORT

BUSINESS MALE COOP 4-YEAR

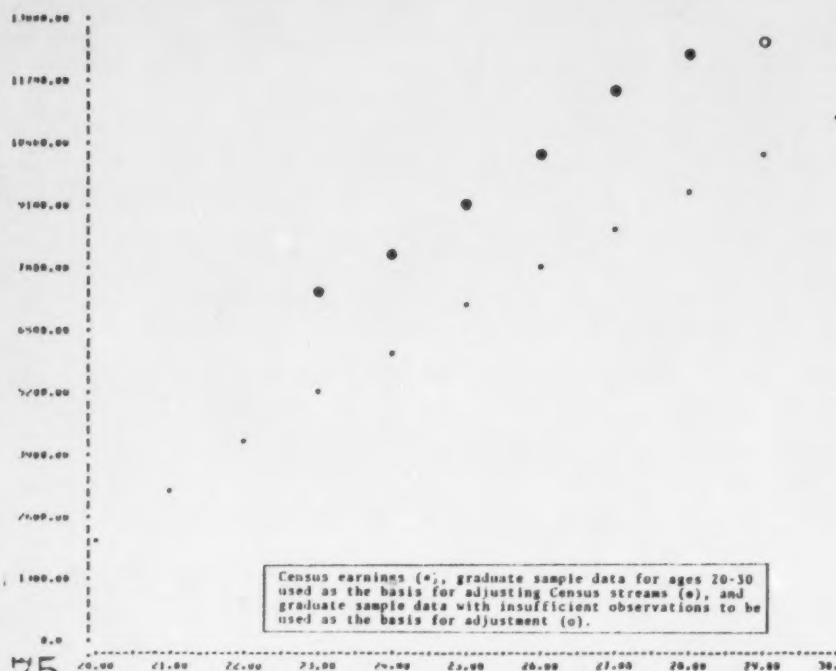
AGE	ERN	GRAD	HMMC4A
20.	2157.	0.	0.
21.	3210.	0.	0.
22.	4221.	0.	0.
23.	5209.	1416.	6772.
24.	6155.	8076.	8081.
25.	7065.	9330.	9184.
26.	7939.	10376.	10320.
27.	8777.	11549.	11410.
28.	9580.	12268.	12453.
29.	10345.	12480.	13450.
30.	11077.	0.	14400.

ALTERNATIVE ADJUSTMENTS TO CENSUS EARNINGS FOR THE COHORT - BUSINESS MALE CO-OP 4-YEAR

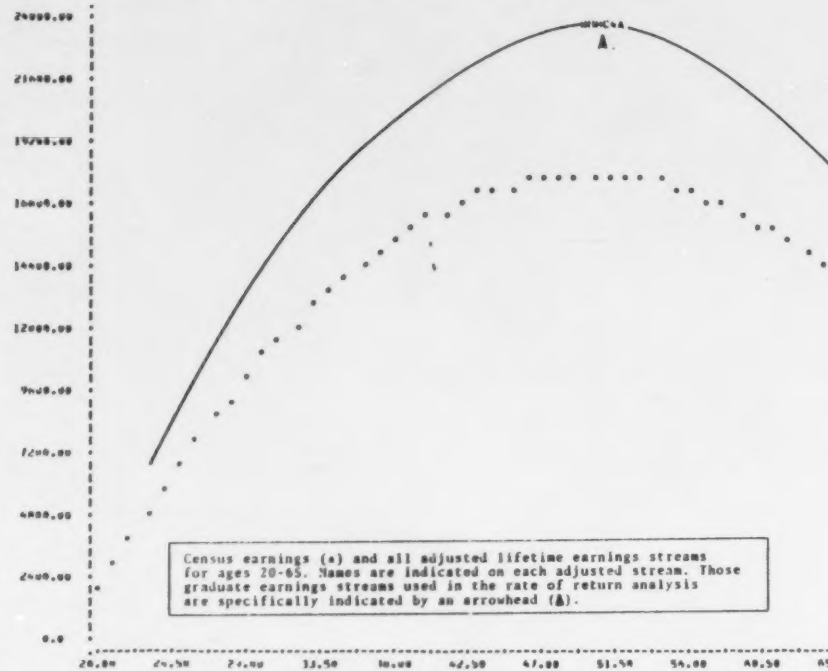
Age	Constant Proportion (HMMC4A)
20	0
21	0
22	0
23	x 1.30
24	x 1.30
25	x 1.30
26	x 1.30
27	x 1.30
28	x 1.30
29	x 1.30
30	x 1.30
...	...
65	x 1.30

Estimated Census earnings data (ERN), graduate sample data (GRAD), and all adjusted streams for ages 20-30.

Streams created by additive or multiplicative adjustment of the Census for the ages 20-65. "+" indicates a constant or varying amount added to the Census earnings data each year. "x" indicates a constant or varying factor multiplied times Census earnings. Zero earnings are specified for all years before graduation.



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EXHIBIT T.20: GRADUATE EARNINGS OF THE BUSINESS MALE NON-CO-OP 4-YEAR COHORT

BUSINESS MALE NONCOOP 4-YEAR

AGE ERN GRAD BMHNA

20.	2151.	0.	0.
21.	3210.	0.	0.
22.	4227.	0.	0.
23.	5209.	4780.	4844.
24.	6155.	6156.	5724.
25.	7065.	6646.	6570.
26.	7939.	6826.	7383.
27.	8777.	8192.	8163.
28.	9580.	8024.	8909.
29.	10340.	9143.	9622.
30.	11077.	0.	10302.

ALTERNATIVE ADJUSTMENTS TO CENSUS EARNINGS FOR THE COHORT - BUSINESS MALE NONCO-OP 4-YEAR

Age	Constant Proportion (BMHNA)
20	0
21	0
22	0
23	x .930
24	x .930
25	x .930
26	x .930
27	x .930
28	x .930
29	x .930
30	x .930
...	...
65	x .930

Estimated Census earnings data (ERN), graduate sample data (GRAD), and all adjusted streams for ages 20-30.

Streams created by additive or multiplicative adjustment of the Census for the ages 20-65. "+" indicates a constant or varying amount added to the Census earnings data each year. "x" indicates a constant or varying factor multiplied times Census earnings. Zero earnings are specified for all years before graduation.

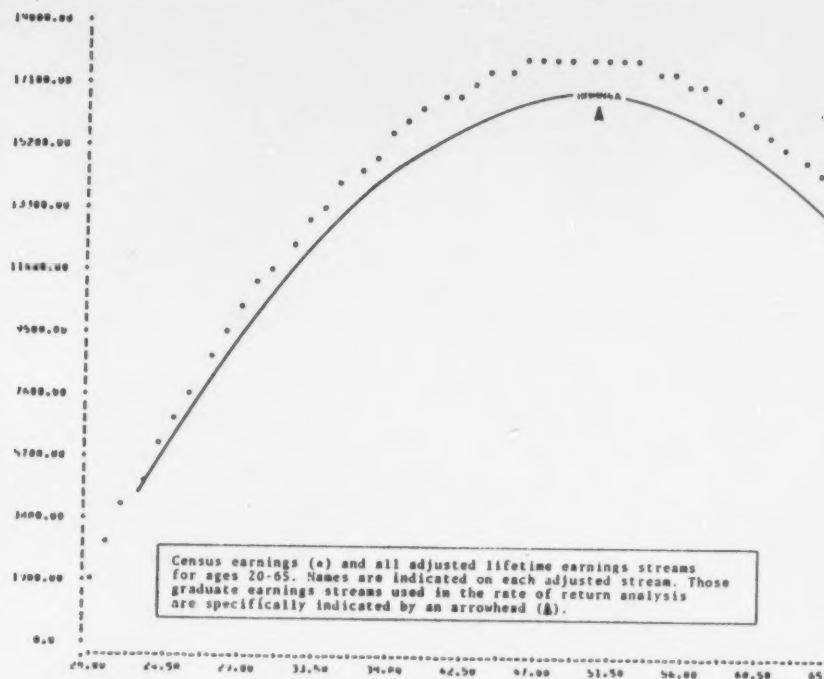
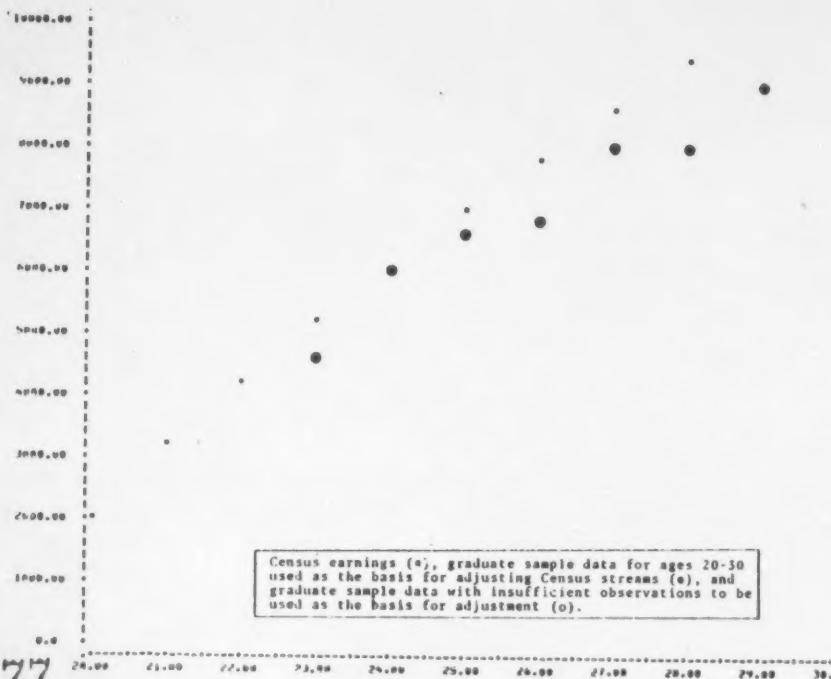


EXHIBIT T.21: GRADUATE EARNINGS OF THE ENGINEERING MALE CO-OP 4-YEAR COHORT

ENGINEERING MALE COOP 4-YEAR

AGE	ERN	GRAD	EAMC4A	EAMC4B
20.	3124.	0.	0.	0.
21.	4182.	0.	0.	0.
22.	5192.	0.	0.	0.
23.	6151.	8898.	8919.	8351.
24.	7054.	9511.	9530.	9259.
25.	7914.	10203.	10215.	10119.
26.	8730.	10957.	11000.	10930.
27.	9494.	11243.	11203.	11694.
28.	10212.	11704.	11743.	12412.
29.	10884.	11953.	11973.	13044.
30.	11512.	0.	12318.	13712.

Estimated Census earnings data (ERN), graduate sample data (GRAD), and all adjusted streams for ages 20-30.

ALTERNATIVE ADJUSTMENTS TO CENSUS EARNINGS FOR THE COHORT - ENGINEERING MALE CO-OP 4-YEAR

Age	Varying Proportion (EAMC4A)	Constant Difference (EAMC4B)
20	0	0
21	0	0
22	0	0
23	x 1.45	+ \$2200
24	x 1.35	+ \$2200
25	x 1.29	+ \$2200
26	x 1.26	+ \$2200
27	x 1.18	+ \$2200
28	x 1.15	+ \$2200
29	x 1.10	+ \$2200
30	x 1.07	+ \$2200
...	...	...
65	x 1.00	+ \$2200

Streams created by additive or multiplicative adjustment of the Census for the ages 20-65. "x" indicates a constant or varying amount added to the Census earnings data each year. "+" indicates a constant or varying factor multiplied times Census earnings. Zero earnings are specified for all years before graduation.

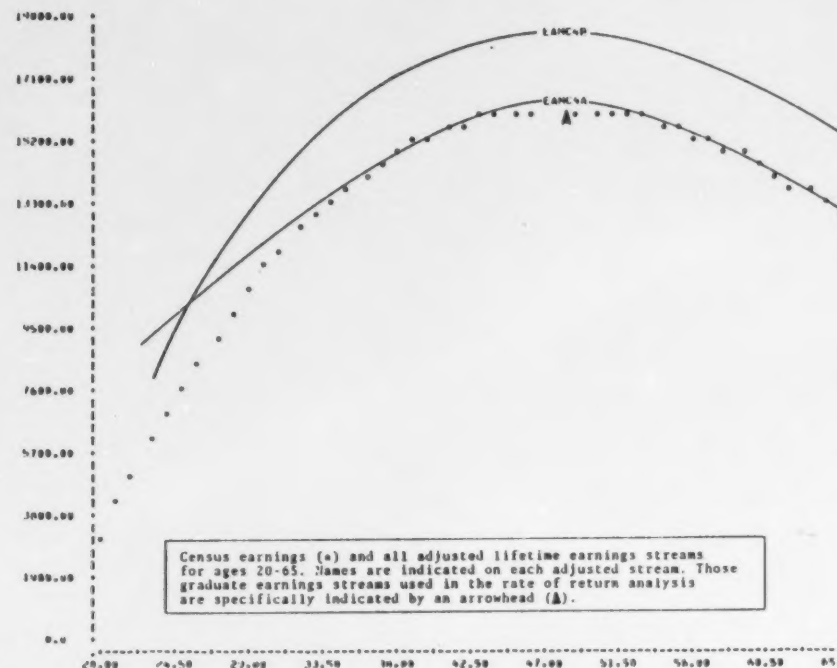


EXHIBIT T.22: GRADUATE EARNINGS OF THE ENGINEERING NON-CO-OP 4-YEAR COHORT

ENGINEERING MALE NONCOOP 4-YEAR

AGE	ERN	GRAD	EAMN4A	EAMN4B
20.	3120.	0.	0.	0.
21.	4182.	0.	0.	0.
22.	5192.	0.	0.	0.
23.	6151.	1278.	1254.	6851.
24.	7054.	8207.	8184.	7759.
25.	7919.	8701.	8711.	8619.
26.	8730.	9419.	9428.	9430.
27.	9494.	10024.	10064.	10174.
28.	10212.	10519.	10518.	10917.
29.	10884.	11153.	10884.	11584.
30.	11512.	0.	11512.	12212.

ALTERNATIVE ADJUSTMENTS TO CENSUS EARNINGS FOR THE COHORT - ENGINEERING MALE NONCO-OP 4-YEAR

Age	Varying Proportion (EAMN4A)	Constant Difference (EAMN4B)
20	0	0
21	0	0
22	0	0
23	x 1.18	+ \$700
24	x 1.16	+ \$700
25	x 1.10	+ \$700
26	x 1.08	+ \$700
27	x 1.06	+ \$700
28	x 1.03	+ \$700
29	x 1.00	+ \$700
30	x 1.00	+ \$700
...	...	...
65	x 1.00	+ \$700

Estimated Census earnings data (ERN), graduate sample data (GRAD), and all adjusted streams for ages 20-30.

Streams created by additive or multiplicative adjustment of the Census for the ages 20-65. "x" indicates a constant or varying amount added to the Census earnings data each year. "+" indicates a constant or varying factor multiplied times Census earnings. Zero earnings are specified for all years before graduation.

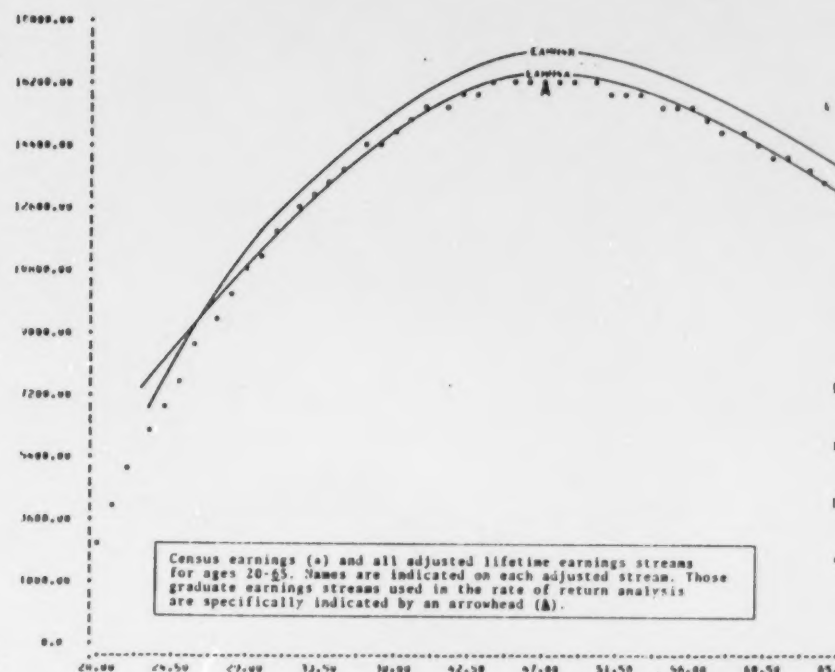
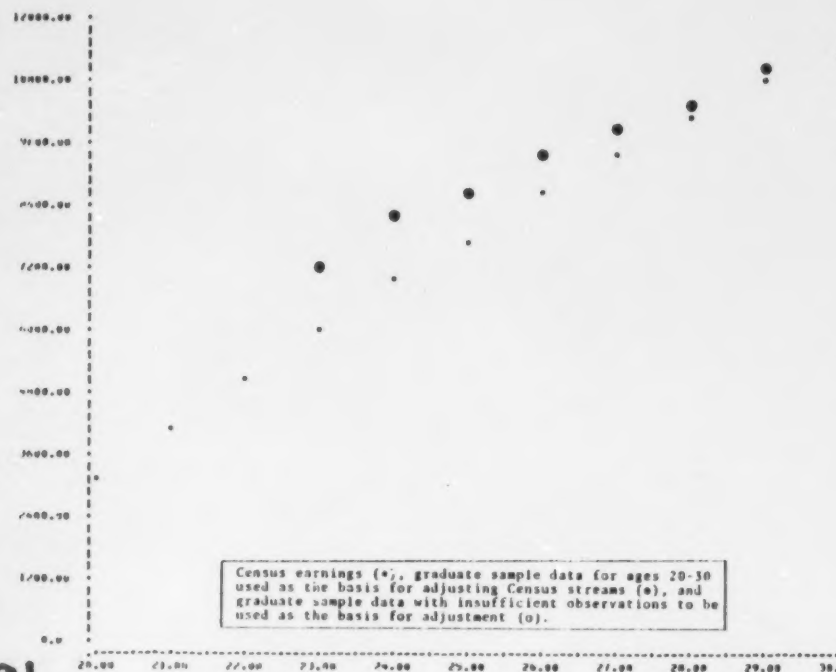


EXHIBIT T.23: GRADUATE EARNINGS OF THE HEALTH MALE NON-CO-OP 4-YEAR COHORT

HEALTH MALE NONCOOP 4-YEAR

AGE	ERN	GRAD	HPMN4A	HPMN4B	HPMN4C	HPMN4D
20.	2164.	0.	0.	0.	0.	0.
21.	2623.	0.	0.	0.	0.	0.
22.	3461.	0.	0.	0.	0.	0.
23.	4678.	4197.	4198.	4694.	4201.	4197.
24.	4674.	6569.	4794.	5609.	6590.	6569.
25.	5247.	7145.	5367.	6297.	7136.	7145.
26.	5798.	7292.	5918.	6957.	7305.	7292.
27.	6325.	6430.	6445.	7590.	8452.	6425.
28.	6847.	7070.	6949.	8195.	8829.	6929.
29.	7310.	5720.	7430.	8772.	7310.	7410.
30.	7765.	0.	7885.	9318.	7765.	7865.

Estimated Census earnings data (ERN), graduate sample data (GRAD), and all adjusted streams for ages 20-30.

ALTERNATIVE ADJUSTMENTS TO CENSUS EARNINGS FOR THE COHORT - HEALTH MALE NONCO-OP 4-YEAR

Age	Constant Difference (HPMN4A)	Constant Proportion (HPMN4B)	Varying Proportion (HPMN4C)	Varying Difference (HPMN4D)
20	0	0	0	0
21	0	0	0	0
22	0	0	0	0
23	+ \$120	x 1.20	x 1.03	+ \$ 119
24	+ \$120	x 1.20	x 1.41	+ \$1895
25	+ \$120	x 1.20	x 1.36	+ \$1898
26	+ \$120	x 1.20	x 1.26	+ \$1494
27	+ \$120	x 1.20	x 1.02	+ \$ 100
28	+ \$120	x 1.20	x 1.00	+ \$ 100
29	+ \$120	x 1.20	x 1.00	+ \$ 100
30	+ \$120	x 1.20	x 1.20	+ \$ 100
...	...	...	...	...
65	+ \$120	x 1.20	x 1.00	+ \$ 100

Streams created by additive or multiplicative adjustment of the Census for the ages 20-65. "+" indicates a constant or varying amount added to the Census earnings data each year. "x" indicates a constant or varying factor multiplied times Census earnings. Zero earnings are specified for all years before graduation.

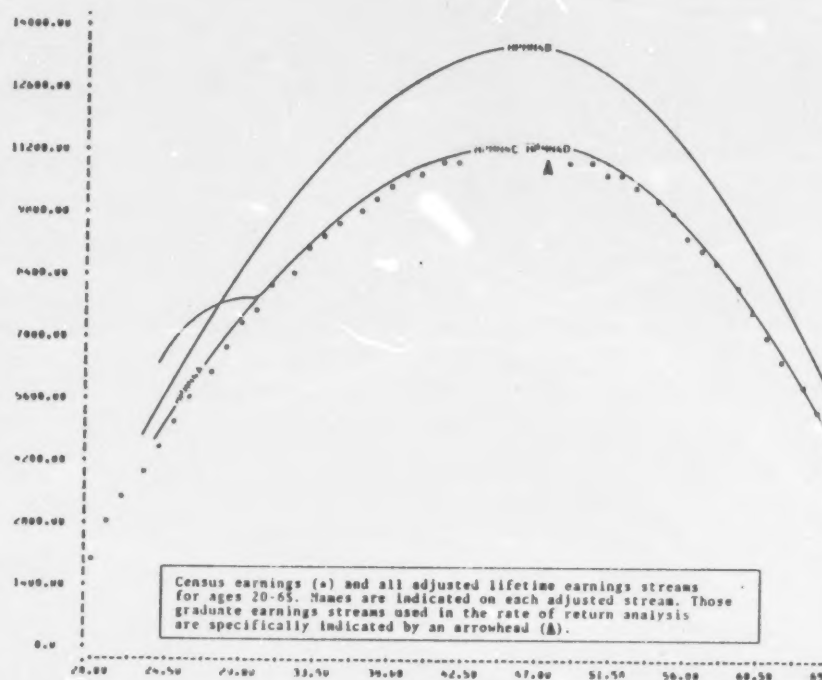
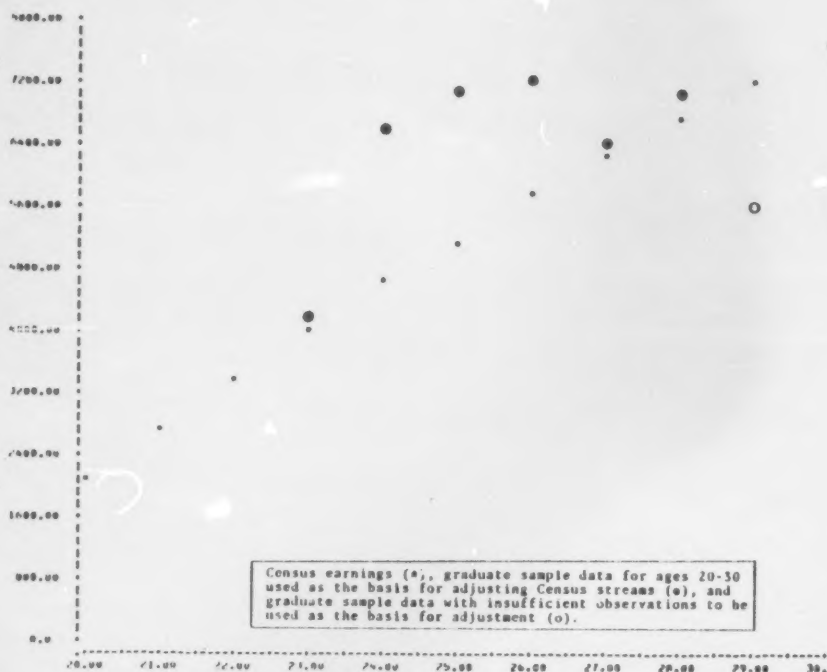


EXHIBIT T.24: GRADUATE EARNINGS OF THE LIBERAL ARTS MALE CO-OP 4-YEAR COHORT

LIBERAL ARTS MALE COOP 4-YEAR

Age	ERN	GRAD	LAMC4A	LAMC4B	LAMC4C
20.	2793.	0.	0.	0.	0.
21.	3685.	0.	0.	0.	0.
22.	4541.	0.	0.	0.	0.
23.	5362.	5518.	5962.	5737.	5523.
24.	6147.	7283.	6747.	6578.	7315.
25.	6848.	8383.	7498.	7380.	8415.
26.	7613.	8227.	8213.	8146.	8222.
27.	8293.	8900.	8893.	8874.	8874.
28.	8938.	9441.	9534.	9565.	9476.
29.	9551.	0.	10151.	10270.	10124.
30.	10127.	0.	10729.	10838.	10736.

ALTERNATIVE ADJUSTMENTS TO CENSUS EARNINGS FOR THE COHORT- LIBERAL ARTS MALE CO-OP 4-YEAR

Age	Constant Difference (LAMC4A)	Constant Proportion (LAMC4B)	Varying Proportion (LAMC4C)
20	0	0	0
21	0	0	0
22	0	0	0
23	+ \$600	x 1.07	x 1.03
24	+ \$600	x 1.07	x 1.19
25	+ \$600	x 1.07	x 1.22
26	+ \$600	x 1.07	x 1.08
27	+ \$600	x 1.07	x 1.07
28	+ \$600	x 1.07	x 1.07
29	+ \$600	x 1.07	x 1.07
30	+ \$600	x 1.07	x 1.07
...	...	...	...
65	+ \$600	x 1.07	x 1.07

Estimated Census earnings data (ERN), graduate sample data (GRAD), and all adjusted streams for ages 20-30.

Streams created by additive or multiplicative adjustment of the Census for the ages 20-65. "+" indicates a constant or varying amount added to the Census earnings data each year. "x" indicates a constant or varying factor multiplied times Census earnings. Zero earnings are specified for all years before graduation.

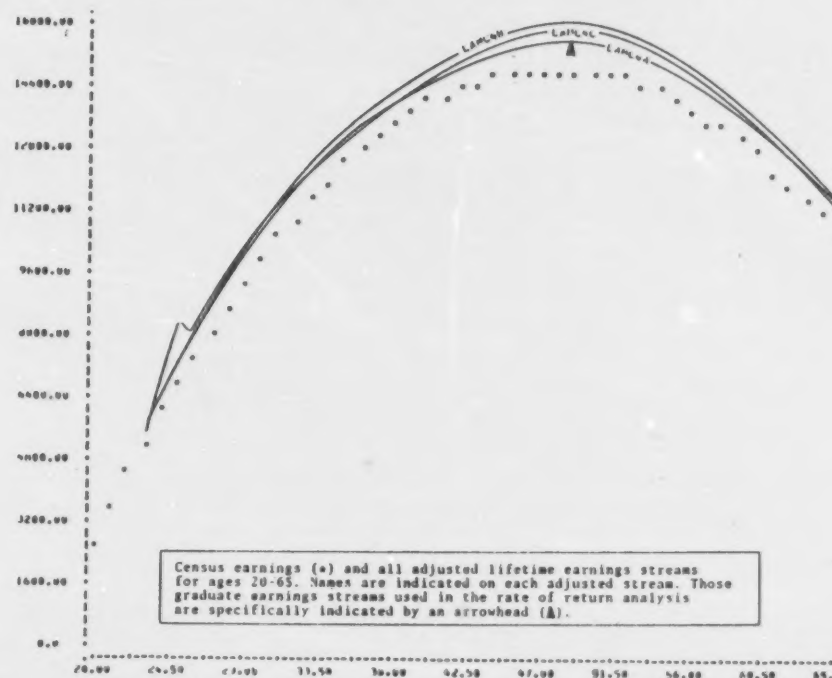
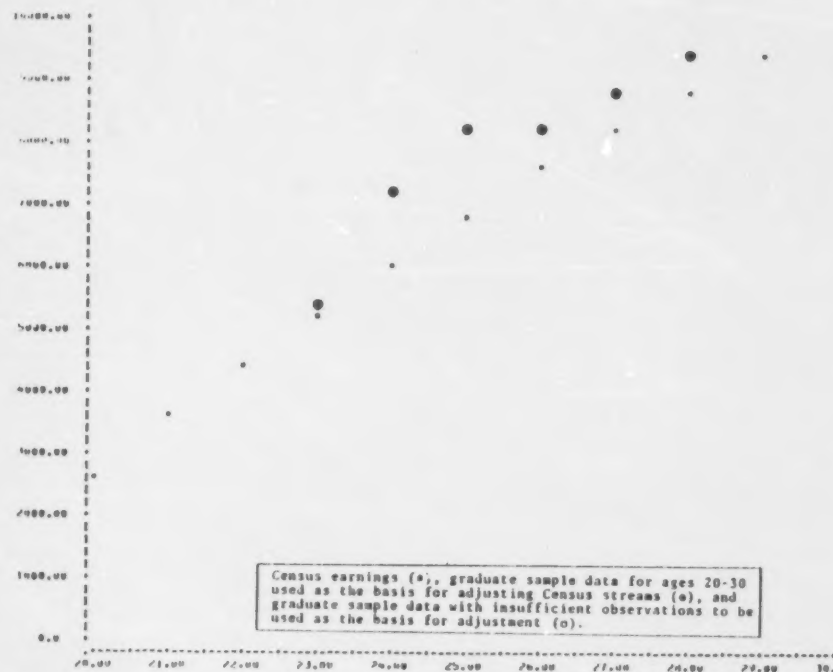


EXHIBIT T.25: GRADUATE EARNINGS OF THE LIBERAL ARTS MALE NON-CO-OP 4-YEAR COHORT

LIBERAL ARTS MALE NONCOOP 4-YEAR

Age	ERN	GRAD	LAMN4A	LAMN4B	LAMN4C
20.	2193.	0.	0.	0.	0.
21.	3085.	0.	0.	0.	0.
22.	4541.	0.	0.	0.	0.
23.	5362.	3001.	4262.	4022.	3802.
24.	6147.	5154.	5047.	4611.	5152.
25.	6898.	5769.	5798.	5173.	5766.
26.	7613.	6565.	6513.	5710.	6562.
27.	8293.	6755.	7193.	6220.	6759.
28.	8934.	6946.	7639.	6704.	6946.
29.	9551.	7252.	8451.	7163.	7259.
30.	10124.	0.	9029.	7597.	7698.

Estimated Census earnings data (ERN), graduate sample data (GRAD), and all adjusted streams for ages 20-30.

ALTERNATIVE ADJUSTMENTS TO CENSUS EARNINGS FOR THE COHORT - LIBERAL ARTS MALE NONCO-OP 4-YEAR

Age	Constant Difference (LAMN4A)	Constant Proportion (LAMN4B)	Varying Proportion (LAMN4C)
20	0	0	0
21	0	0	0
22	0	0	0
23	- \$1100	x .750	x .709
24	- \$1100	x .750	x .838
25	- \$1100	x .750	x .836
26	- \$1100	x .750	x .862
27	- \$1100	x .750	x .815
28	- \$1100	x .750	x .777
29	- \$1100	x .750	x .760
30	- \$1100	x .750	x .760
...	...	...	...
65	- \$1100	x .750	x .760

Streams created by additive or multiplicative adjustment of the Census for the ages 20-65. "+" indicates a constant or varying amount added to the Census earnings data each year. "x" indicates a constant or varying factor multiplied times Census earnings. Zero earnings are specified for all years before graduation.

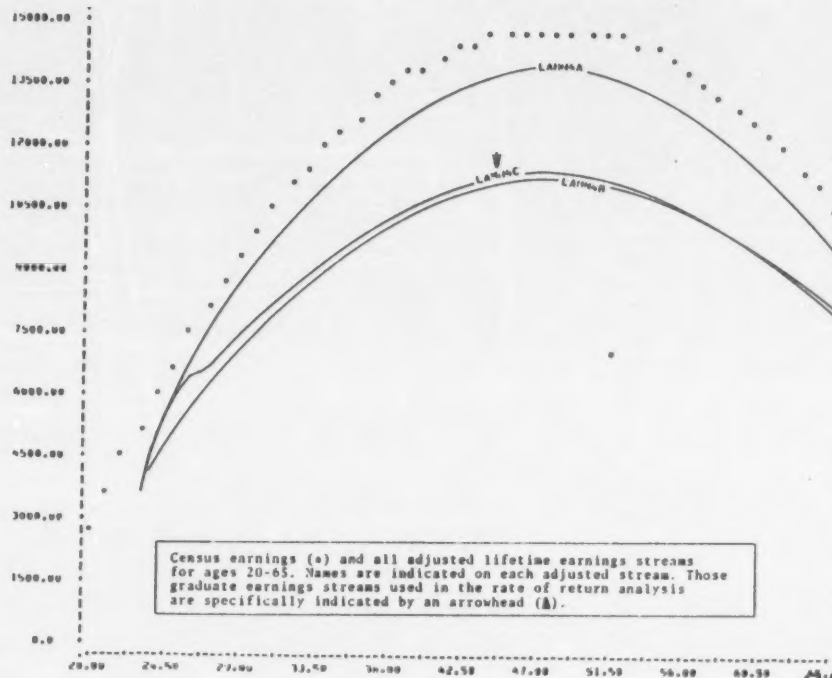


EXHIBIT T.26: GRADUATE EARNINGS OF THE TRADE AND INDUSTRIAL MALE NON-CO-OP 4-YEAR COHORT

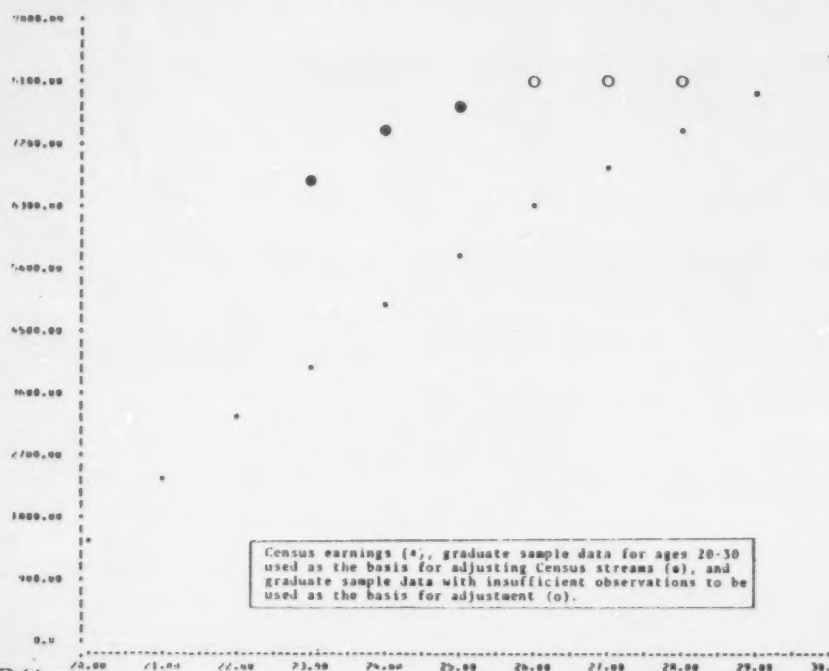
TRADE AND INDUSTRIAL MALE NONCOOP 4-YEAR

AGE	ERN	GRAD	TIMN4A	TIMN4B	TIMN4C
20.	1554.	0.	0.	0.	0.
21.	2462.	0.	0.	0.	0.
22.	3329.	0.	0.	0.	0.
23.	4132.	6730.	6732.	6280.	6735.
24.	4899.	7545.	7499.	7446.	7544.
25.	5621.	7901.	8221.	8544.	7926.
26.	6301.	8123.	8901.	9577.	8191.
27.	6944.	8185.	9538.	10545.	8325.
28.	7544.	8180.	10133.	11456.	8361.
29.	8047.	0.	10687.	12292.	8411.
30.	8601.	0.	11201.	13074.	8601.

ALTERNATIVE ADJUSTMENTS TO CENSUS EARNINGS FOR THE COHORT - TRADE AND INDUSTRIAL MALE NONCO-OP 4-YEAR

Age	Constant Difference (TIMN4A)	Constant Proportion (TIMN4B)	Varying Proportion (TIMN4C)
20	0	0	0
21	0	0	0
22	0	0	0
23	+ \$2600	x 1.52	x 1.63
24	+ \$2600	x 1.52	x 1.54
25	+ \$2600	x 1.52	x 1.41
26	+ \$2600	x 1.52	x 1.3
27	+ \$2600	x 1.52	x 1.2
28	+ \$2600	x 1.52	x 1.11
29	+ \$2600	x 1.52	x 1.04
30	+ \$2600	x 1.52	x 1.00
...	...	...	...
65	+ \$2600	x 1.52	x 1.00

Estimated Census earnings data (ERN), graduate sample data (GRAD), and all adjusted streams for ages 20-30.



Streams created by additive or multiplicative adjustment of the Census for the ages 20-65. "+" indicates a constant or varying amount added to the Census earnings data each year. "x" indicates a constant or varying factor multiplied times Census earnings. Zero earnings are specified for all years before graduation.

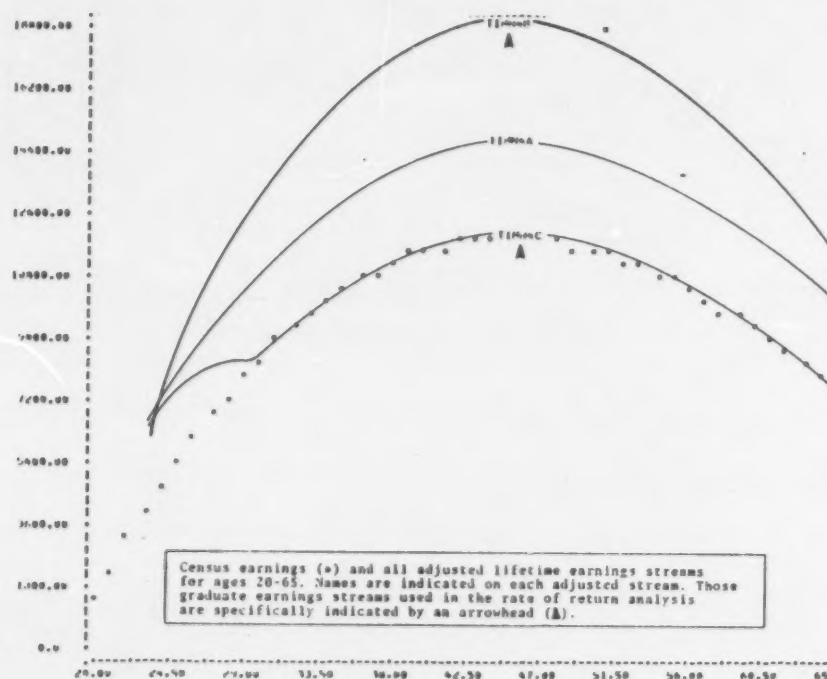
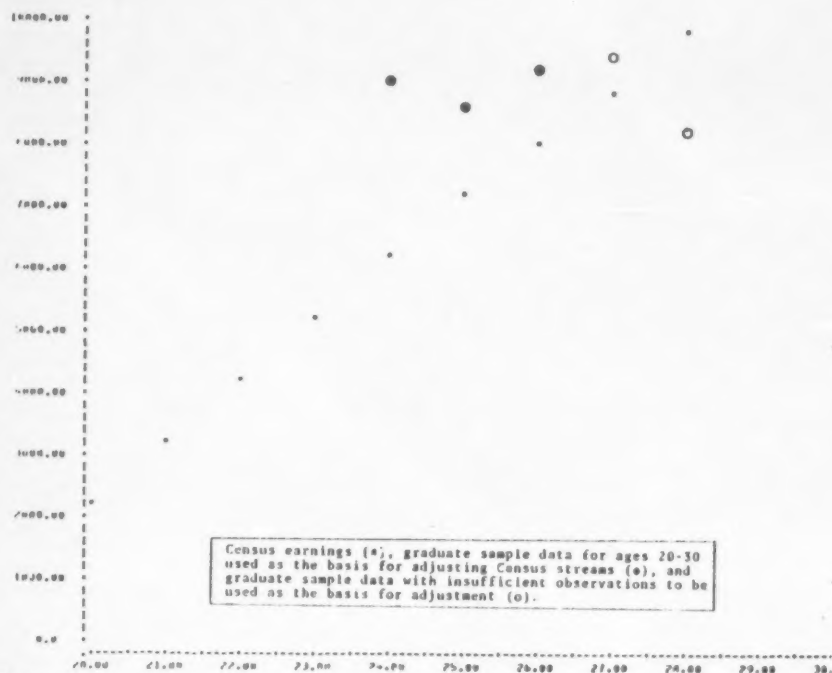


EXHIBIT T.27: GRADUATE EARNINGS OF THE BUSINESS MALE CO-OP 5-YEAR COHORT

BUSINESS MALE COOP 5-YEAR

AGE	ERN	GRAD	BHMC5A	BHMC5B	BHMC5C
20.	2330.	0.	0.	0.	0.
21.	3375.	0.	0.	0.	0.
22.	4390.	0.	0.	0.	0.
23.	5373.	0.	0.	0.	0.
24.	6375.	4005.	7401.	7825.	8982.
25.	7245.	6682.	8471.	8746.	8695.
26.	8134.	9248.	9517.	9534.	9273.
27.	8991.	9490.	10513.	10497.	9799.
28.	9811.	1255.	11481.	11313.	10304.
29.	10809.	0.	12405.	12104.	10816.
30.	11361.	0.	13292.	12861.	11361.

Estimated Census earnings data (ERN), graduate sample data (GRAD), and all adjusted streams for ages 20-30.



ALTERNATIVE ADJUSTMENTS TO CENSUS EARNINGS FOR THE COHORT - BUSINESS MALE CO-OP 5-YEAR

Age	Constant Proportion (BHMC5A)	Constant Difference (BHMC5B)	Varying Proportion (BHMC5C)
20	0	0	0
21	0	0	0
22	0	0	0
23	0	0	0
24	x 1.17	+ \$1500	x 1.42
25	x 1.17	+ \$1500	x 1.20
26	x 1.17	+ \$1500	x 1.14
27	x 1.17	+ \$1500	x 1.09
28	x 1.17	+ \$1500	x 1.05
29	x 1.17	+ \$1500	x 1.02
30	x 1.17	+ \$1500	x 1.00
...	...	...	...
65	x 1.17	+ \$1500	x 1.00

Streams created by additive or multiplicative adjustment of the Census for the ages 20-65. "0" indicates a constant or varying amount added to the Census earnings data each year. "x" indicates a constant or varying factor multiplied times Census earnings. Zero earnings are specified for all years before graduation.

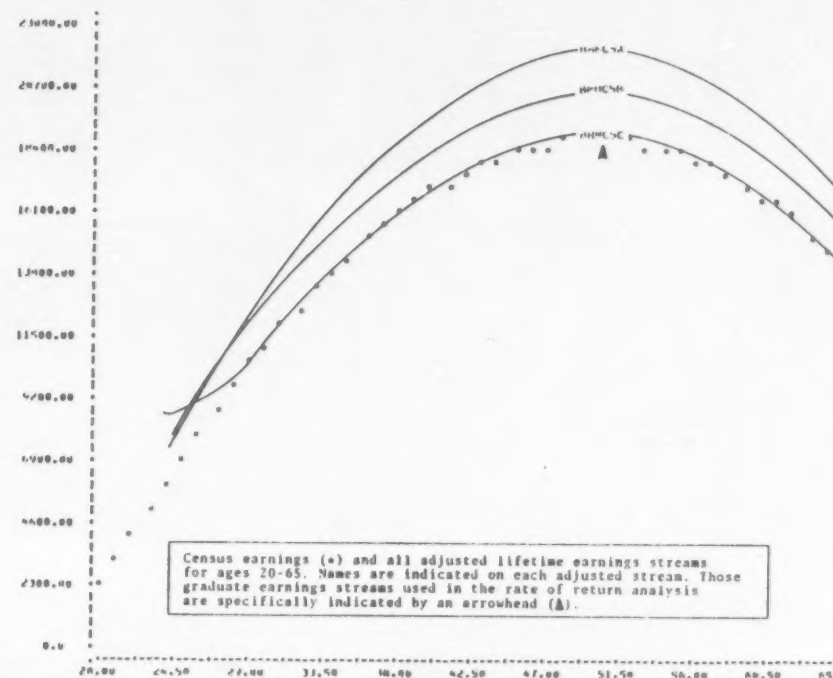


EXHIBIT T.28: GRADUATE EARNINGS OF THE ENGINEERING MALE CO-OP 5-YEAR COHORT

ENGINEERING MALE COOP 5-YEAR

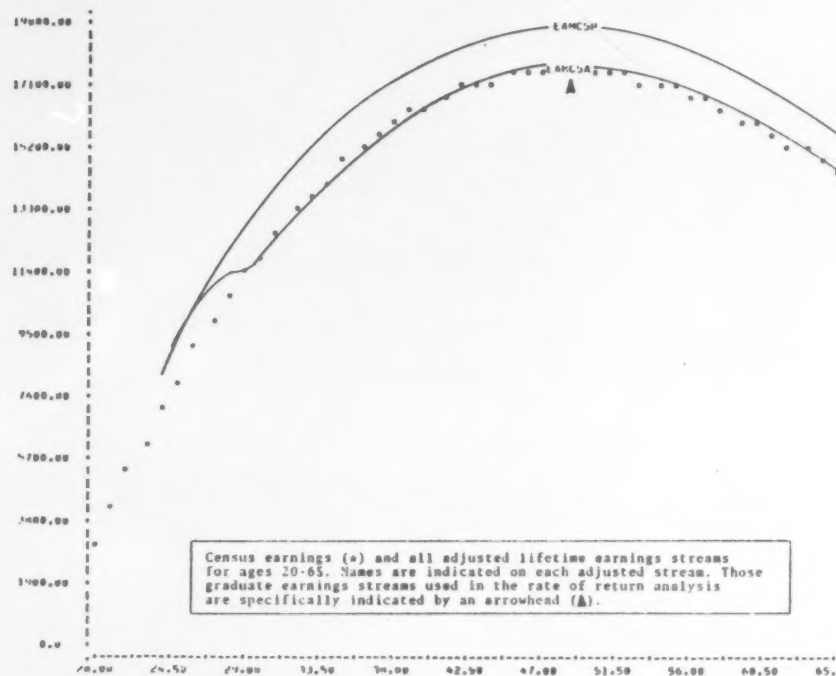
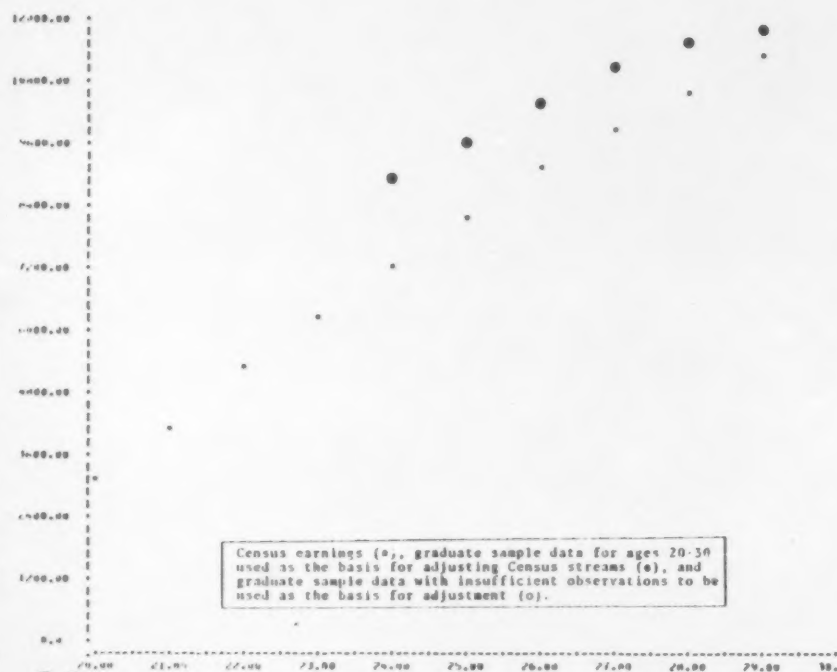
Age	ERN	GRAD	EAMCSA	EAMCSB
20	5192	0	0	0
21	4305	0	0	0
22	5175	0	0	0
23	6343	0	0	0
24	7361	9035	9053	8661
25	8274	9760	9685	7578
26	1143	10353	10334	10445
27	9465	11258	11260	11265
28	10117	11523	11489	12037
29	11463	11766	11692	12763
30	12143	0	12143	13443

ALTERNATIVE ADJUSTMENTS TO CENSUS EARNINGS FOR THE COHORT - ENGINEERING MALE CO-OP 5-YEAR

Age	Varying Proportion (EAMCSA)	Constant Difference (EAMCSB)
20	0	0
21	0	0
22	0	0
23	0	0
24	x 1.23	+ \$1500
25	x 1.17	+ \$1500
26	x 1.13	+ \$1500
27	x 1.13	+ \$1500
28	x 1.07	+ \$1500
29	x 1.02	+ \$1500
30	x 1.00	+ \$1500
...	...	...
65	x 1.00	+ \$1500

Estimated Census earnings data (ERN), graduate sample data (GRAD), and all adjusted streams for ages 20-30.

Streams created by additive or multiplicative adjustment of the Census for the ages 20-65. "x" indicates a constant or varying amount added to the Census earnings data each year. "x" indicates a constant or varying factor multiplied times Census earnings. Zero earnings are specified for all years before graduation.



adjustment procedures are described and named in the upper right quadrant. A numerical summary of the first few years of the original Census observations, the graduate earnings, and the first few years of each of the adjusted earnings streams (using the names supplied in the upper right quadrant) are displayed in the upper left quadrant. Finally, the original standard Census lifetime earnings profile and each of the alternative adjusted lifetime graduate earnings streams are named and presented graphically in the lower right quadrant of the exhibit for each cohort. Note that the "best" or both the "high" and the "low" alternatives (i.e., that income stream or streams that was carried throughout the rate of return analysis) are clearly indicated with an arrowhead.

2. Student Experience

This subsection describes the creation of the cost and benefit elements which comprise the student experience. These include:

- student costs;
- tuition;
- student taxable earnings; and
- student non-taxable income.

Each of these elements was constructed from data items on the student questionnaires but each was handled in a unique fashion.

a. C_t^i : Student Costs for Cohort i at Time t

Individual student costs were calculated by summing, for each student record, the expenditures on "books and supplies," "tools and equipment," and "other expenditures." Expenditures for food, housing, and transportation were excluded due to the fact that no baseline data were available to adjust the reported data in order to approximate the marginal changes in these costs which can be attributed to college attendance. In any case, it is likely to be the case that these marginal differences are very small relative

to the total expenditures for food, housing, and transportation. It is also likely to be the case that these total expenditures would be very large compared to the other student costs which were included and which are associated with college attendance. Thus, inclusion of these costs would seriously bias the results by clouding the true variability in cost associated with various forms of postsecondary education.

Mean student costs were then computed by program length, co-op status, and discipline area. It was assumed that these costs did not vary by sex or years in school. The procedure initially involved the calculation of mean cohort costs by school, with the final cohort-school means. This allowed the weights to be the school rather than the distribution of students, which may vary substantially from the distribution of graduates sampled.

b. T_t^i : Tuition for Cohort i at Time t

Mean tuition figures were tabulated only according to program length. It was assumed that tuition did not vary by sex, co-op status, or year in school, and could not be measured differentially by discipline area within each school. Of course, means were calculated initially for each school in the sample and then an overall mean calculated for each program length, so that the weighting of the overall means would be by school rather than student.

c. ET_t^i : Student Taxable Earnings for Cohort i at Time t

Student taxable earnings were computed for each student by summing co-op earnings, non-co-op earnings, and summer earnings. Means were then tabulated for each sex, co-op status, program length, discipline area, school, and year in school combination. A grand mean was then calculated for each sex, co-op status, program length, discipline area, and year-in-school

combination by averaging across the schools represented in the student sample. In this case, however, the school means do not receive equal weight in the calculation of the grand mean, rather, each school mean was weighted by the number of graduates in the co-op status, program length, discipline area combination. Note that the weight does not consider (or is calculated by pooling across) the sex and year-in-school attributes. Weighting by the number of graduates was to facilitate the linking of the student experience with the graduate experience in terms of compatibility.

d. NT_t^i : Student Non-Taxable Income for Cohort i at Time t

Student non-taxable incomes consisted of scholarships, grants, and awards, tuition subsidies, student loans, etc. These transfer payments were calculated for each cohort in exactly the same manner as described above for taxable earnings.

e. As a summary, the four student cost and revenue items were calculated as school means first and then grand means were calculated from these school means. In the case of the cost items, the school means were given equal weights, but for revenue items each school was weighted by the number of graduates in the cohort, not considering the year in school or sex attributes. Table T.7 displays for each student cost and revenue item the attribute combinations for which the item was calculated. Thus, tuition is differentiable only by program length whereas for the revenue items each student cohort (as defined by sex, co-op status, program length and discipline area) will be associated with 2, 4 or 5 revenue measures depending on the program length inherent in the cohort definition.

TABLE T.7: ATTRIBUTES OF STUDENT COST AND REVENUE ITEMS

ITEM DESCRIPTION	ATTRIBUTES				
	SEX	CO-OP STATUS	PROGRAM LENGTH	DISCIPLINE AREA	YEAR-IN SCHOOL
C_t^i : Student Costs		X	X	X	
T_t^i : Tuition			X		
ET_t^i : Taxable Earnings	X	X	X	X	X
NT_t^i : Non-Taxable Earnings	X	X	X	X	X

3. E_t^i : Value of Initial Endowment for Cohort i at Time t

All investment options to be evaluated during the rate of return analysis are to be from the point of view of a recent high school graduate. Such students have accrued, as a result of completing their secondary education, a wealth endowment. This wealth endowment is equivalent to, and can be represented by, an expected stream of income. This stream of income can, of course, be measured by the composite earnings streams of high school graduates. Such earnings are obviously foregone during the post-secondary education experience, and must be subtracted from graduate earnings in order to calculate the incremental earnings attributable only to that postsecondary education.

Endowment streams for both male and female were constructed from Census data on those with 4 years of high school training. The cell-interval Census data were converted to a continuous function using the technique described above for the standard Census lifetime income profiles after being adjusted for labor force participation. These endowments are presented on Exhibits T.29 and T.30 for females and males, respectively.

EXHIBIT T.29: ENDOWMENT EARNINGS OF HIGH SCHOOL EDUCATED FEMALES

AGE	EARN	AGE	EARN
18.	2511.	42.	2577.
19.	2451.	43.	2517.
20.	2394.	44.	2451.
21.	2333.	45.	2387.
22.	2318.	46.	2321.
23.	2298.	47.	2154.
24.	2264.	48.	2143.
25.	2247.	49.	2014.
26.	2230.	50.	2041.
27.	2230.	51.	2053.
28.	2230.	52.	2047.
29.	2234.	53.	2004.
30.	2243.	54.	2013.
31.	2255.	55.	2027.
32.	2273.	56.	2033.
33.	2294.	57.	2033.
34.	2313.	58.	2023.
35.	2344.	59.	2013.
36.	2373.	60.	2072.
37.	2404.	61.	2077.
38.	2437.	62.	2050.
39.	2471.	63.	2014.
40.	2506.	64.	2071.
41.	2542.	65.	2020.

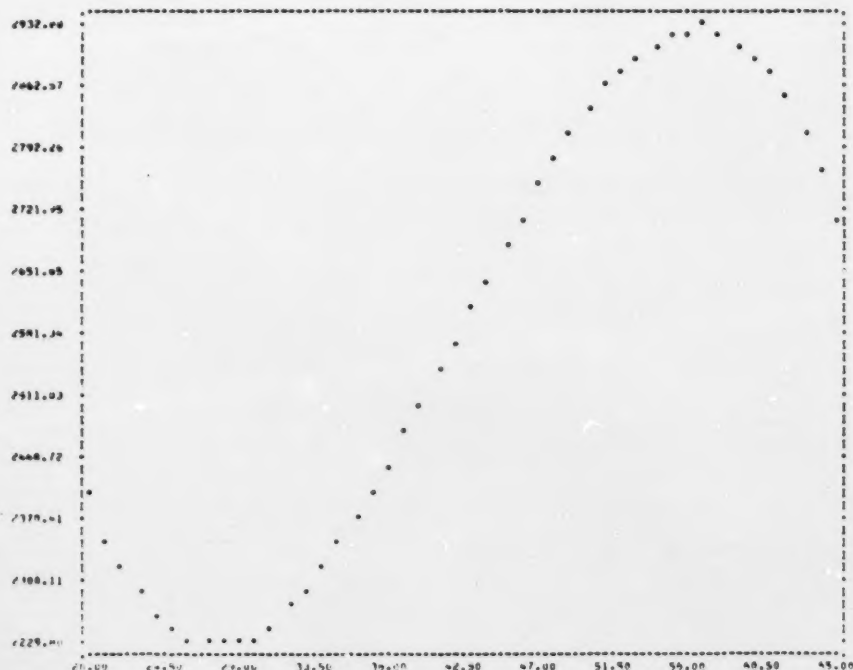
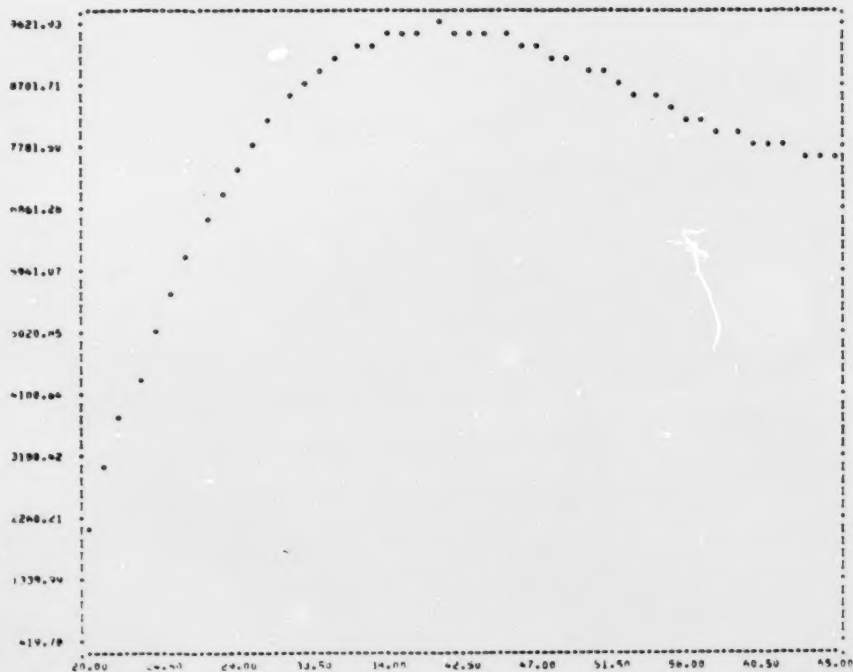


EXHIBIT T.30: ENDOWMENT EARNINGS OF HIGH SCHOOL EDUCATED MALES

AGE	E	AGE	E
18.	420.	42.	9417.
19.	1340.	43.	9501.
20.	2201.	44.	9543.
21.	3004.	45.	9640.
22.	3751.	46.	9615.
23.	4463.	47.	9333.
24.	5023.	48.	9238.
25.	5672.	49.	9135.
26.	6212.	50.	9024.
27.	6705.	51.	8911.
28.	7153.	52.	8784.
29.	7550.	53.	8643.
30.	7915.	54.	8543.
31.	8237.	55.	8427.
32.	8521.	56.	8311.
33.	8761.	57.	8203.
34.	8974.	58.	8101.
35.	9150.	59.	8001.
36.	9302.	60.	7923.
37.	9414.	61.	7852.
38.	9507.	62.	7790.
39.	9564.	63.	7755.
40.	9607.	64.	7731.
41.	9622.	65.	7721.



4. Construction of Net Benefit Streams

The data and adjustments presented thus far represent all of the elements which comprise the various cohort-specific net benefit streams. It now remains the task of these notes to describe the procedure by which these elements are combined into cohort-specific net benefit streams and placed into a time frame in preparation of the rate of return analysis to follow. The net benefit to an individual of a particular cohort at a particular point in time is given by the equation:

$$(12) \quad N_t^i = S_t^i \left[Tx \cdot (1.015^t \cdot G_t^i + ET_t^i) - Tx(1.015^t \cdot E_t^i) + NT_t^i - T_t^i - C_t^i \right]$$

where, to recapitulate, the elements are as follows:

- N_t^i is the net benefit specific by cohort and age,
- S_t^i is the survival rate specific only by age, sex, and program length,
- G_t^i is graduate earnings specific by the cohort definition variables and time,
- ET_t^i is student taxable earnings specific by the cohort definition variables and years in school,
- E_t^i is endowment earnings measured from the earnings of a high school graduate and is specific only by sex and age,
- NT_t^i is student non-taxable income specific by the cohort definition variables and years in school,
- T_t^i is tuition specific only by program length,
- C_t^i is other students costs specific by program length,
- 1.015^t is the cross-sectional data bias adjustment which is solely time dependent, and
- Tx is the proportion of retained earnings which is dependent upon the level of adjusted graduate earnings, student taxable earnings and endowment earnings.

Using equation (12), a series of data points (N_t^i) were created for each cohort to represent the net benefits between the ages of 19 and 65.

Equation (12) represents more than just a combination of the separate graduate and student, cost and revenue items. There are several more adjustments that are introduced by this equation:

- cross-sectional data bias adjustment;
- tax adjustment; and
- survival adjustments.

Before describing each of these adjustments, however, the student costs and revenue of equation (12) underwent one other adjustment. All these values were converted to constant dollars to account for inflation between the time of the Census and the time of the survey.

a. Inflation Adjustment

Each of the elements of the student experience (earnings, other income, tuition, and costs) was deflated by a factor of .658. This was to adjust for increases in the Consumer Price Index that took place between the time of the Census data (about June 1969) and the collection of student data (about January 1976). This also makes the student data comparable to the graduate data which were converted to constant dollars as described above.

b. Cross-Section Data Bias Adjustment

The use of cross-sectional data in the creation of time series net benefit streams creates a bias if not adjusted for the typical productivity increases which take place over time, and which will be reflected in earnings. Therefore, to account for the secular growth of earnings over time due to productivity

increases, both the graduate earnings streams and high school endowment earnings were increased at a yearly rate of 1.5 percent; which is approximately the historical rate of productivity increase in the United States.

c. Tax Adjustment

The private benefits accruing to students/graduates are not properly represented by gross earnings figures, but rather, the level of earnings retained after taxes. This factor did not significantly influence student earnings, but for graduates the introduction of a tax adjustment avoided a serious overestimate of the effective benefits to each cohort. Student earnings, graduate earnings, and high school endowment earnings were all deflated by a factor, Tx, which represents the proportion of earnings retained after taxes. Tx was developed as a function of income level from the Internal Revenue Service publication, Statistics of Income 1970; Individual Income Tax Returns, 79(10-72). These income-related after-tax proportions are reported in Table T.8.

d. Survival Adjustments

In assessing the value of particular educational investments from the point of view of the high school graduate, it is not sufficient to simply measure the monetary net benefits at each point during the lifetime. The probability that an individual will live to benefit from his/her earnings potential must also be taken into account. To adjust for this factor the entire stream of net benefits was deflated by the probability of survival of the individual from graduation to each specific age. Net benefits were not survivor adjusted during the college years because this study assesses the value of alternative completed courses of study. Thus, all students were assumed to survive at least until college graduation. Six survival rate schedules were computed which were specific by sex and program length from the HEW publication Vital Statistics of the United States, 1970; (HRA) 75-1101. These survival schedules are reported in Table T.9.

TABLE T.8: AVERAGE TAX BILL AND PROPORTION OF EARNINGS RETAINED BY YEARLY INCOME

INCOME	AVERAGE TAX BILL	PROPORTION OF EARNINGS RETAINED	INCOME	AVERAGE TAX BILL	PROPORTION OF EARNINGS RETAINED
\$ 800	\$ 19	.976	\$ 9500	\$1038	.891
\$ 1000	\$ 25	.975	\$10000	\$1100	.890
\$ 1500	\$ 38	.975	\$10500	\$1174	.888
\$ 2000	\$ 90	.955	\$11000	\$1250	.886
\$ 2500	\$ 147	.941	\$11500	\$1340	.883
\$ 3000	\$ 210	.930	\$12000	\$1430	.881
\$ 3500	\$ 287	.918	\$12500	\$1521	.878
\$ 4000	\$ 340	.915	\$13000	\$1600	.877
\$ 4500	\$ 397	.912	\$13500	\$1682	.875
\$ 5000	\$ 450	.910	\$14000	\$1770	.874
\$ 5500	\$ 512	.907	\$14500	\$1869	.871
\$ 6000	\$ 570	.905	\$17500	\$2390	.863
\$ 6500	\$ 634	.902	\$20000	\$2935	.853
\$ 7000	\$ 695	.901	\$22500	\$3490	.845
\$ 7500	\$ 762	.898	\$25000	\$4100	.836
\$ 8000	\$ 825	.897	\$27500	\$4718	.828
\$ 8500	\$ 894	.895	\$40000	\$7800	.805
\$ 9000	\$ 965	.893			

TABLE T.9: PROBABILITY OF SURVIVAL TO SPECIFIED AGES BY SEX AND PROGRAM LENGTH

AGE	FEMALE			MALE		
	2-YEAR	4-YEAR	5-YEAR	2-YEAR	4-YEAR	5-YEAR
20	1.000	1.000	1.000	1.0000	1.0000	1.000
21	.999850	1.000	1.000	.999549	1.0000	1.000
22	.999699	1.000	1.000	.999097	1.0000	1.000
23	.999548	.999848	1.000	.998645	.999549	1.000
24	.999398	.999699	.999850	.998194	.999097	.999548
25	.999222	.999523	.999674	.997789	.998692	.999142
26	.999047	.999348	.999498	.997384	.998286	.998737
27	.998872	.999173	.999323	.996980	.997882	.998332
28	.998696	.998996	.999147	.996574	.997476	.997926
29	.998521	.998821	.998972	.996170	.997071	.997521
30	.998285	.998585	.998736	.995711	.996612	.997061
31	.998050	.998350	.998501	.995253	.996153	.996603
32	.997814	.998114	.998265	.994794	.995694	.996143
33	.997578	.997878	.998029	.994308	.995208	.995657
34	.997343	.997643	.997794	.993877	.994776	.995225
35	.996977	.997277	.997427	.992752	.993650	.994098
36	.996610	.996911	.997061	.992627	.993525	.993973
37	.996244	.996544	.996695	.992002	.992900	.993348
38	.995879	.996179	.996330	.991378	.992275	.992723
39	.995513	.995813	.995963	.990754	.991650	.992097
40	.994965	.995265	.995415	.989791	.990687	.991134
41	.994416	.994716	.994866	.988829	.989723	.990170
42	.993869	.994168	.994318	.987868	.988762	.989208
43	.993321	.993620	.993770	.986909	.987802	.988248
44	.992774	.993073	.993223	.985950	.986842	.987287
45	.991933	.992231	.992381	.984453	.985344	.985788
46	.991093	.991391	.991541	.982958	.983847	.984241
47	.990252	.990551	.990700	.981466	.982353	.982797
48	.989413	.989711	.989861	.979976	.980862	.981305
49	.988575	.988873	.989022	.978488	.979373	.979815
50	.987346	.987643	.987792	.976169	.977052	.977493
51	.986119	.986416	.986565	.973856	.974737	.975177
52	.984893	.985189	.985338	.971548	.972427	.972866
53	.983669	.983965	.984113	.969245	.970122	.970560
54	.982445	.982741	.982890	.966948	.967823	.968259
55	.980656	.980951	.981099	.963329	.964201	.964636
56	.978871	.979.66	.979313	.959724	.960592	.961025
57	.977089	.977383	.977530	.956132	.956997	.957429
58	.975310	.975604	.975751	.952554	.953415	.953845
59	.973534	.973827	.973974	.948989	.949847	.950276
60	.970957	.971249	.971396	.943641	.944494	.944920
61	.968386	.968678	.968824	.938322	.939171	.939545
62	.965822	.966113	.966259	.933034	.933878	.934299
63	.963265	.963555	.963701	.927775	.928615	.929034
64	.960715	.961004	.961149	.922547	.923382	.923798
65	.958171	.948459	.958604	.917349	.918178	.918593

Following these adjustments and the exercise of equation (12), the entire student/graduate net benefit lifetime profile for each cohort will have been specified. It will be positive and continuous during the graduate years, but negative and discontinuous during the student years. A typical lifetime net benefit profile for a cohort will appear as in Figure T.4.

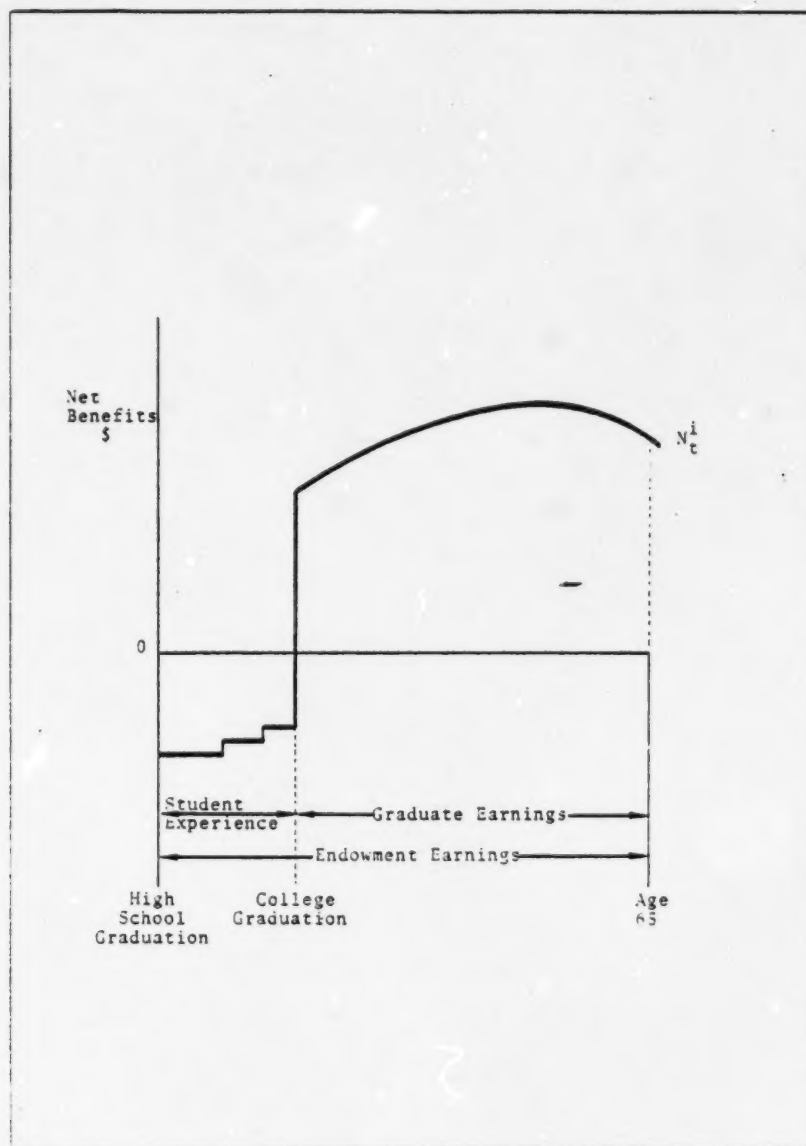


FIGURE T.4: TYPICAL LIFETIME EDUCATIONAL INVESTMENT-EARNINGS CYCLE

C. Rate of Return Methodologies

Having calculated the individual elements of the net benefit stream, N_t^i , the next step in the analysis is to convert each alternative lifetime net benefit stream into a point estimate. There are three interrelated procedures traditionally used to do this, each with a different purpose. All, however, involve the discounting of the stream of net benefits for each cohort back to present values at the time of high school graduation when the decision among mutually exclusive alternatives is being made. These three techniques are the calculation of Internal Rates of Return, Present Values, and Fisher's Rate of Return Over Cost. The Present Value of an investment is the value of the stream of expected future net benefits, N_t^i discounted to the present. An Internal Rate of Return is the discount rate at which the present value of net benefits is equal to zero. Likewise, Fisher's Rate of Return Over Cost is that rate of discount at which the present value of the difference in net benefits between mutually exclusive alternative investments is equal to zero.

Each of these three approaches was applied in the analysis of cost and benefits. Internal Rates of Return are useful to determine whether or not an investment in college education of any particular type is profitable. Fisher's Rate of Return Over Cost will help establish whether cooperative education is more financially rewarding than alternative ways of completing a college education. Finally, to get some idea of the relative importance of benefits throughout the range of probable interest rates for both co-op and non-co-op programs, cardinal measures of profitability were needed. The calculation of present values provides the necessary estimates.

In order to discuss the procedures used, Section C is divided into five subsections. Subsection 1 will discuss the theory of the present value calculations. Subsections 2 and 3 will discuss the Internal Rate of Return and Fisher's Rate of

Return Over Cost methodologies. Subsection 4 will discuss the interrelationships between these three methodologies and, finally, Subsection 5 will explain the algorithm actually used to discount the net benefit streams.

1. Present Value

The present values were calculated in Chapter 2 to evaluate cohort net benefit streams at discount rates from 0 to 20 percent, i.e., the likely range of potential interest rates in the money markets available to students/graduates. The equation used for this purpose was:

$$(13) \quad PV_r^i = \int_0^n \left(N_t^i \right) e^{-rt} dt \quad \text{where,}$$

PV_r^i is the present value of the net benefit stream of cohort i at discount rate r ,

n is the years of working life from high school graduation to age 65,

N_t^i represents the net benefit stream for cohort i , and

r is the discount rate.

This equation will determine the present worth of a particular college course of study (or, in fact, any investment) at alternative rates of discount. Naturally, the higher the relevant present value, the more financially rewarding the investment. The relationship between the level of the present value, the magnitude of cohort-specific net benefits, and the discount or interest rate may best be illustrated by the following example.^{1/}

^{1/} This example uses discrete rather than continuous discounting in order to simplify the mathematics. Continuous discounting was used during the study however (see Section C.5, below). The relationship between the two is as follows:

$$\lim_{x \rightarrow \infty} \sum_t \left(\frac{1}{\left(1 + \frac{r}{x}\right)^{t/x}} \right) = e^{-rt}.$$

Suppose an individual has the alternatives of receiving \$1.00 today or \$1.00 one year from now.^{1/} These alternatives are not equivalent in terms of the satisfaction provided by each dollar. If \$1.00 today is exchanged for \$1.00 a year from now, more satisfaction will be given up than is gained from the deferred receipt of one dollar. The reason is that the individual will forego the use of one dollar during the year, reducing the "range of possible actions." Given that "more is preferred to less," \$1.00 received in one year provides less satisfaction than a current dollar. Under the circumstances, an individual would be unwilling to make such an exchange. The individual would, however, be willing to give up a smaller amount now in exchange for \$1.00 a year from now. This would involve determining the current amount of purchasing power that yields the same utility as the deferred dollar. Suppose that amount is \$.90. Then we can say that the current, or present, value of the receipt of \$1.00 in one year is \$.90. The difference between \$1.00 now and the present value of \$1.00 a year from now, \$.90, is the value in a utility sense of having the dollar available for use during the year. In other words, it is the value of "earlier availability" to the individual. Another way of saying the same thing is that the difference of \$.10 is the value of the individual's "time preference" for current as opposed to future income (or current vs. future compensation). Expressed as a percent of \$.90, the value of "earlier availability" is 11 percent and is defined as the rate of interest.

Thus, the rate of interest is the value, or price, of earlier availability that must be paid in order to induce individuals to forego current receipts for future receipts. In the example used here, if an individual is willing to give up \$.90 now for \$1.00 in a year, and can do so, then an exchange of

^{1/} The discussion of the rate of interest and present values in this section is based on Armen A. Alchian and William R. Allen, University Economics (2nd ed., Belmont, Cal., Wadsworth Publishing Co., 1967), pp. 199-209.

current for future payments will take place. That is, if the rate of interest is 11 percent, \$.90 now will be given up for \$1.00 a year from now. This example illustrates the principle that a time preference for current, relative to future, income and consumption implies the existence of a positive interest rate.^{1/} Two other points brought out by the example are important for present purposes. First, the present value of \$1.00 received in a year depends on the rate of interest. The lower the value (price) of earlier availability, the higher the present value of future payments. Secondly, the benefits (i.e., utility) of future receipts are evaluated in terms of the present value of those receipts.

The formal link between the rate of interest and the present value of future payments can be demonstrated as follows. In the previous example, \$.90 is lent for one year at an interest rate of 11 percent. At the end of the year, \$.90 + .11 x \$.90 = \$1.00 is received by the lender. More generally, if A dollars are to be received in a year and the rate of interest is 11 percent, the present value (i.e., current price) of the A dollars is

$$(14) \quad PV_1 = \frac{A}{(1+r)} ,$$

where r, the interest rate, is 11 percent. In a similar manner, the present value of A dollars to be received two years from now is

$$(15) \quad PV_2 = \frac{A}{(1+r)^2} ,$$

Note that the present value of deferred payments falls as the period of deferment lengthens. For example, if A = \$1.00 and r = .11, the $PV_1 = $.90$ and $PV_2 = $.80$. In general the present value of A dollars to be received in n years is

^{1/} In addition to the utility of earlier availability, a positive rate of interest also reflects (1) preference for the certainty of present consumption compared to the uncertainty of future consumption and (2) the ability to use resources now to earn higher income. See Alichian and Allen, University Economics, p. 201.

$$(16) \quad PV_n = \frac{A}{(1+r)^n},$$

The interest rate also determines the present value of a sequence of payments to be received in future periods, as is the situation with each cohort-specific net benefit stream. Suppose \$1.00 will be received in each of the next n years. The value is then simply the sum of present values for each of the n years.^{1/}

$$(17) \quad PV = \sum_t^n \frac{\$1.00}{(1+r)^t}$$

Note that the present value, or worth, of the sequence of receipts is less than their undiscounted sum. This reflects the fact that the rate of interest is positive. That is, individuals prefer current receipts and consumption to receipts in future periods. In addition, the present value of a multi-period sequence is a current measure of the benefits of future receipts in the sequence, as is true of the one period example cited previously. In the case of a particular educational investment and the resultant benefits, we might ask ourselves what is the dollar amount which could be given to an individual at the time of his graduation from high school which, in strict financial terms, would leave him equally well off throughout his lifetime as if he had continued with that college investment? That dollar amount is the present value of the college educational investment evaluated at the relevant rate of interest.

Investment projects require outlays or costs and yield benefits or receipts in both current and future periods. The definition of present value given in the preceding discussion

^{1/} Equation (17) is the discrete time equivalent of equation (16) for use when payments (benefits) come at single points in time during an interval. For streams which provide benefits continuously as is the case with the cohort net benefits streams, equation (16) is more appropriate.

suggests how the costs and benefits of investments can be measured by their present values. For a single investment considered as an increment to a combination of investment projects, the present value rule is to adopt the investment if its present value is greater than zero (i.e. $PV > 0$). For two or more mutually exclusive investments on the other hand, as is relevant here, the decision rule is to select the alternative with the highest present value. The rationale for these rules is that they will result in adoption of investments that increase the overall wealth of the investor. This is consistent with the objective of choosing the combination of investment projects that maximize present value. Unfortunately the rate of interest at which to calculate the present values is often in doubt. Under these circumstances alternative investment criteria are often employed. One such alternative criterion is the Internal Rate of Return.

2. Internal Rate of Return

The question of whether a particular college investment is financially rewarding within a range of feasible market interest rates may be answered by finding the discount rate at which they cease to become profitable. If this discount rate is well above the interest rates that might normally be expected, it can be stated that the particular investment is profitable. This discount rate may be found for cohort i by solving equation (18) for ρ :

$$(18) \quad \int_0^n (N_t^i) e^{-\rho t} dt = 0$$

where,

N_t^i represents the net benefit stream as calculated in equation (1) for cohort i ,

n is the years of working life from high school graduation to age 65, and

ρ is the Internal Rate of Return.

This provides an unambiguous indication of the profitability of an investment opportunity only if the market interest rate is known. That is, the internal rate criteria can be applied to determine whether or not a given investment is profitable at the current market rate of interest (i.e., the interest rate which must be paid to finance the investment). Also, in this context, the internal rate of return can be characterized as that rate of discount that equates the present values of negative net benefits during the investment period and positive net benefits thereafter.^{1/}

Given that the internal rate of return has been computed, the use of it in assessing the profitability of an investment is based on a comparison of the internal rate of return with the relevant market rate of interest. The investment rule can be stated as follows:

If the internal rate of return on an investment exceeds the relevant market rate of interest, the investment will be profitable. The rationale underlying this rule is clear. The internal rate is that discount rate at which the present value of an investment is zero. The present value of net benefits computed at lower rates of discount (i.e., the market interest rate) would therefore be positive. Adoption of an investment based on this rule would therefore lead to an increase in the wealth of the investor. This approach is illustrated by the following example:

Consider an investment with the series of expected annual receipts -1, 2, 1 received at the beginning of each annual

^{1/} To compute a unique positive internal rate of return for an investment, the sequency of net returns must be such that negative net benefits occurs first, followed by positive net benefits. The problem of multiple solutions of (1) can occur when the net benefit stream changes sign more than once. The number of roots is determined by Descarte's rule of signs. See J. Hirshleifer, Investment, Interest, and Capital, (Englewood Cliffs, N.J.: Prentice-Hall, Inc.), pp. 53-55 and pp. 77-79.

period.^{1/} The internal rate of return, ρ , for this investment is obtained by solving the equation (19):

$$(19) \quad PV = \frac{-1}{(1+\rho)^0} + \frac{2}{(1+\rho)^1} + \frac{1}{(1+\rho)^2} = 0.$$

The positive root of this expression is $\rho = \sqrt{2}$, or 141.4 percent. This is shown in Figure T.5 where the curve intersects the discount rate (horizontal) axis at $\rho = 1.414$ (i.e., $PV = 0$ at $r = 1.414$, so that $\rho = 1.414$). At lower rates of interest, PV is positive, and at $\rho = 0$, $PV = -1 + 2 + 1 = 2$.

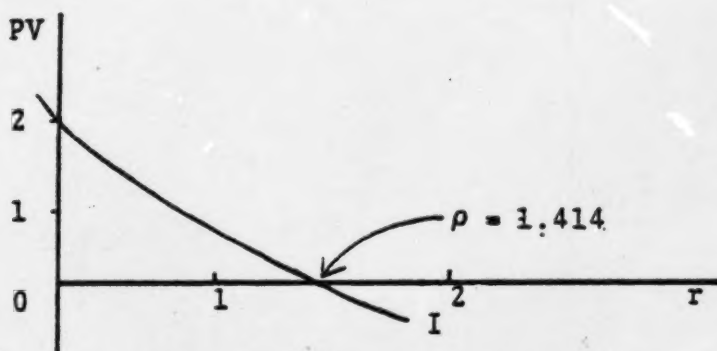


FIGURE T.5: PRESENT VALUES AND THE INTERNAL RATE OF RETURN FOR NET BENEFIT STREAM (-1, 2, 1)

Suppose there are two mutually exclusive investment opportunities to choose from, and that internal rates of return have been computed for each. Since these represent alternative investments, one approach to making a selection between them would be to choose the investment with the highest internal rate of return. The important question here is whether or not this rule will lead to the selection of the most profitable investment. That is, will this criterion choose the one with the highest present value, and if the rule breaks down, what alternative investment criteria can be applied?

^{1/} This example is taken from Hirshleifer, Investment, Interest, and Capital, pp. 75-76. Discrete discounting is used here rather than continuous discounting for simplicity of exposition only.

Suppose the net returns from alternative I are given by -1, 2, 1 from the preceding example and that the sequence of net receipts for alternative II is -1, 0, 4. The internal rate for alternative I is 141.4 percent (as before), and the internal rate for alternative II as computed in the same manner, is 100 percent. The present values of each investment at different rates of interest are shown as curves I and II in Figure T.6.

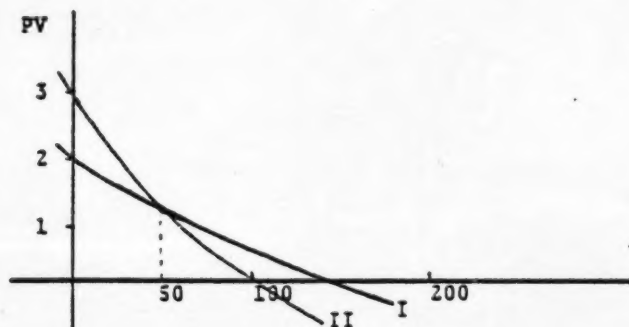


FIGURE T.6: A COMPARISON OF NET BENEFIT STREAMS $(-1, 2, 1)$ and $(-1, 0, 4)$.

I intersects the horizontal axis at a higher discount rate than II since its internal rate of return exceeds II's. On the other hand at a zero rate of discount, alternative II has a higher present value than alternative I, so that the two present value curves also intersect each other at some discount rate. In the example, the intersection occurs at a discount rate of 50 percent. That is, at a discount rate of 50 percent the two alternatives have equal present values. Clearly, selecting alternative I on the basis of a higher internal rate of return would be correct only if the market rate of interest was above 50 percent, i.e., when alternative I also has the higher present value. If the market rate of interest is below 50 percent, alternative II is to be preferred.

In other words, Figure T.6 clearly demonstrates that at interest rates below 50 percent, II is more profitable because its present value is higher. At interest rates above 50 percent,

however, I is more profitable. In this example, the most profitable investment depends on the level of the market rate of interest. If the choice were made on the basis of a comparison of internal rates, I would always be chosen over II. Thus, when comparing the cost effectiveness of two mutually exclusive investments, the internal rate of return rule can result in choosing the less profitable alternative.

There are cases, of course, for which a comparison of internal rate will always result in choosing the investment with the higher present value. When the net benefits of one investment opportunity are greater than the net benefits of another in every period, i.e. one investment option dominates another, the internal rate of return for the former will exceed the internal rate of return of the latter. Furthermore, at every rate of interest, the present value of the investment with the higher net benefits will exceed the present value of the other investment. This is illustrated in Figure T.7.

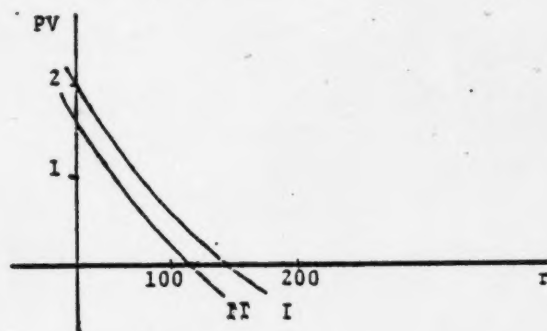


FIGURE T.7: PRESENT VALUES AND INTERNAL RATES OF RETURN WHEN THE NET BENEFITS OF ONE INVESTMENT DOMINATES THE NET BENEFITS OF ANOTHER ALTERNATIVE

The curve labeled I represents the present value of alternative I, at various discount rates, while curve II gives the present value of alternative II. I is shown to dominate II so that its internal rate is greater than that of II. Furthermore, the present value of I is greater than the present value of II for every rate of interest. Clearly, when one of two

mutually exclusive investment alternatives dominates the other, the one with the higher internal rate of return will always be the more profitable.

The Internal Rate of Return is measured in this study as that rate of discount at which the present value of the net benefit stream of a particular investment option; i.e., the algebraic sum each year of the option's lifetime (1) direct costs (such as tuition), (2) indirect costs (such as high school endowment earnings foregone by attending a postsecondary institution), and (3) lifetime earnings (such as scholarships, student earnings and graduate earnings); equals zero. This is the market rate of interest at which the investment option under consideration ceases to be financially viable. If the Internal Rate of Return is below the relevant range of interest rates, the option is not attractive at any interest rate within the range, so that the examination of a series of present values is unnecessary. On the other hand, if the Internal Rate of Return is above the relevant range of interest rates, the option is profitable at any probable market rate of interest. If the internal rate of return falls within the range of relevant market interest rates, then one must have more specific knowledge regarding probable interest rates to decide if the option is financially rewarding. Thus, we have the rule that if the internal rate is above the market rate or the range of market rates, the investment gains a positive return, and vice versa.

It should also be noted that the internal rate indicates only the range of profitable interest rates for the option under consideration, but not how financially rewarding the option is. Only the present value at a rate of discount equal to the market rate of interest describes the level of pecuniary returns to the investment option. Using the internal rate as an investment criterion among mutually exclusive alternatives will not guarantee the selection of the most attractive investment option.

That is, if option A has a higher internal rate than option B, this does not necessarily mean that option A has a higher present value at the market rate of interest than option B. Internal rates will determine if either or both of the options have positive returns, but not which has the highest returns. (If the market rate of interest is between the internal rates of options I and II, of Figure T.6, then logic does imply that option I is preferred.) What is needed, therefore, is a procedure and decision rule for determining the most rewarding investment alternative given a rate of interest. Just as the Internal Rate of Return determines the interest rate at which an investment ceases to become profitable, Fisher's Rate of Return Over Cost finds the interest rate (if any) at which one investment alternative ceases to become more profitable than another.

3. Fisher's Rate of Return Over Cost

Fisher's Rate is defined as that rate of discount at which two mutually exclusive investment options have equal present values. At this rate of discount, one is indifferent between the two options. Also note that above this rate, one option is always preferred (has a higher present value), whereas below this rate, the other option is always preferred (has a higher present value). By knowing the position of Fisher's Rate of Return Over Cost relative to the probable range of interest rates, one can unambiguously state which option has the higher present value (i.e., is preferred as the more financially rewarding) within the range of market interest rates without examining the entire series of present values. Again, however, the determination of how much more rewarding (in terms of present values) one investment option is over the other requires a comparison of present values at the prevailing market rate of interest.

Following the example cited earlier for Figure T.6, recall that investment I had a net benefit stream of -1, 2, 1

whereas investment II had a net benefit stream of -1, 0, 4. By subtracting stream I from II, we have a stream of 0, -2, 3, the "Internal Rate of Return" for which is 50 percent as shown in Figure T.6. Thus the "crossover point" or Fisher's Rate of Return Over Cost between alternative I and alternative II is 50 percent. The decision rule is then as follows:

If the market rate of interest is below 50 percent, choose option II. If the market rate of interest is above 50 percent, choose option I. If the market rate of interest is equal to 50 percent, either option will provide the same level of profit. The use of Fisher's Rate of Return Over Cost is equivalent to calculating a series of present values of each alternative at different discount rates and comparing the results. It is convenient in that it indicates the market rate of interest at which the preference switches from one alternative to the other. That is, Fisher's Rate of Return Over Cost is that discount rate at which there is a crossover or intersection of the present value curves of two mutually exclusive alternatives. The discount rate of 50 percent computed for the discrete three period example in Figure T.6 is an illustration of Fisher's Rate of Return Over Cost. It, of course, does not indicate the degree of profitability (only the calculation of the present values will reveal this), but it does assist in the correct choice of alternatives when the market rate of interest is not known with certainty. It is possible for Fisher's rate of Return Over Cost not to exist. This indicates that the net benefit streams of the two investments never cross, and one investment dominates the other at all interest rates (see Figure T.7). When using present value calculations in the presence of a variety of investment options, a large number of one-on-one comparisons must be made, particularly when the relevant market interest rate is not known. In this situation, Fisher's Rate of Return Over Cost provides a helpful shortcut because it is a single, unambiguous measure whereby a judgment can be made as to the

relative attractiveness of two mutually exclusive investments at all rates of interest.

To determine the effect of sex, discipline area, and co-op/non-co-op status have on the private returns from alternative courses of study, selected net benefit streams were compared two at a time with only one of the cohort-determining variables varying. For example, when examining the impact of discipline area on the cost-effectiveness of college education, program length, sex, and co-op/non-co-op status were held constant. In this manner, the impact of each individual variable was determined by the establishment of the discount rate (f) found by solving equation (20):

$$(20) \quad \int_0^n \left(N_t^1 - N_t^2 \right) e^{-ft} dt = 0$$

where,

n is the years of working life from high school graduation to age 65,

N_t^1 and N_t^2 are the net benefit streams of two mutually exclusive educational investments, and

f is Fisher's Rate of Return Over Cost.

Note that Fisher's Rate of Return Over Cost in equation (20) exhibits a similarity to the calculation of the Internal Rate of Return in equation (18). The internal rate evaluates a particular investment (college education); Fisher's Rate of Return Over Cost, on the other hand, compares mutually exclusive alternative investments (co-op versus non-co-op college education). The theory and algorithms involved in these two calculations are the same, although the interpretations of the results are quite different. Recall that internal rates are evaluations of college training. Fisher's Rate employs the same mathematical algorithm, but compares two college investments directly (say,

co-op and non-co-op college training). One option is considered the opportunity cost of the other, and the net benefit stream used is the algebraic difference between the net benefit streams used in the internal rate calculations for each alternative. (Note that the high school endowments in the net benefit streams for each investment alternative cancel each other out.)

4. Integration of Investment Decision Criteria

To this point, the theory and interpretation of the measures of present value, internal rate, and Fisher's Rate have been discussed in isolation. Each of these measures has a specific purpose and may be employed to address different questions but, in actuality, none of these indices by itself can be used to make knowledgeable investment decisions in the absence of knowledge of the exact level of the relevant market rate of interest. This point may be illustrated by referring to an example of alternative investments.

Figure T.8 illustrates the relationships among the three techniques. Portrayed are two college investment options, A and B. The internal rates of return for each are labeled r_a and r_b , respectively, where the present values of options A and B are zero. At market rates of interest below each internal rate, the option under consideration has a positive return (i.e., has a positive present value). If the market rate of interest is r_1 , only option A has a positive return.

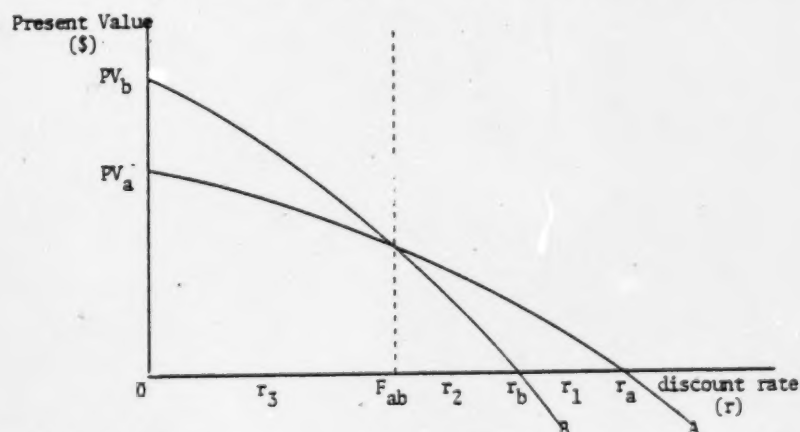


FIGURE T.8 : COMPARISON OF INVESTMENT ALTERNATIVES -- PRESENT VALUES, INTERNAL RATES, AND FISHER'S RATE OF RETURN OVER COST

Fisher's Rate of Return Over Cost is the rate of discount, F_{ab} , at which the present value of the two options, A and B, are equal. The investor is indifferent between the options at this rate of discount.

Note, however, that at market rates of interest above the Fisher's Rate, say, r_2 or r_1 , Option A is preferred, whereas at market rates of interest below the Fisher's Rate, say, r_3 , Option B is preferred. Also note that choosing option A on the basis of the fact that $r_a > r_b$ is correct if, and only if, the market rate of interest is above F_{ab} . Using only information on internal rates, one could make a correct choice only if the market rate of interest is above r_b . At market rates of interest below r_b , one must either calculate present values or use Fisher's Rate to determine which is the more financially rewarding. Thus, it is easily apparent that these techniques must be used in tandem to be effective information devices. Reliance solely on the internal rate of return will provide spurious information if the market rate of interest is below Fisher's Rate. Using only present value calculations complicates the issue by requiring many calculations at various interest rates. Finally, using only Fisher's Rate as an investment criteria may provide information by which alternative investments may be ranked but gives little information as to the magnitude of the difference in ranking or whether the investments are profitable at all. Accordingly, Chapter 2 used each of these techniques to answer essentially three questions:

- Are particular educational investments profitable? (internal rate)
- What are the magnitudes of benefits associated with each alternative? (present value)
- Can these alternatives be ranked and if so, are are these rankings constant? (Fisher's Rate)

5. The Discounting Algorithm

The specific algorithm actually used employs continuous discounting, and is designed to smooth step-function net benefit

streams. For example, let t_1 be the elapsed time in years from the initial investment to the attainment of any level of the net benefit step-function, and let t be the elapsed time in years to the end of the step, then the flow of net benefits from t_1 to $t_1 + t$ is represented by the linear function $(a + bt)$, where a is the net benefit level of the current step and $a + b$ is the net benefit level of the next step. For steps of one year, the present value is determined by:

$$(21) \int_0^1 (a + bt) e^{-r(t_1 + t)} dt = - \left(\frac{a}{r} + \frac{bt}{r} + \frac{b}{r^2} \right) e^{-r(t_1 + t)} \Big|_0^1$$

After evaluating this integral between each annual adjacent pair of net benefit step-function levels, the values are summed to obtain the total present value.

As a practical matter, continuous discounting results in a slightly higher level of discounting because of the compounding effect. For example, at a rate of discount of 10 percent, the discount factor is .909 with discrete discounting, whereas it is .905 with continuous discounting.

That is, $e^{-.1} = .905$, while $\frac{1}{1.1} = .909$.

The use of continuous discounting will produce a lower present value than discrete discounting when using the same discount rate r . This is equivalent to saying that continuous compounding will cause a sum to grow faster than when compounding at finite intervals, even though the compounding rate is the same. The appropriate concept to use when dealing with human capital and the rate of time preference of individuals is continuous discounting. The reader should be aware of the possibility of small differences when comparing the results of this study with those of others than employ discrete discounting (compounding) because of data constraints or simplicity. Such differences will be very small, however, and likely to be swamped by errors of measurement, assumption regarding income profile construction, the use of interval data, etc.